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FIRE TELEGRAPHS.

THIS all important question has again been brought to notice by the paper recently read before the Society of Telegraph-Engineers and Electricians by Mr. E. Bright. Although the paper itself was practically but a re-statement of what was already familiar to the majority of the members of the society, yet it showed that the subject had at last begun to occupy the position which it ought to have assumed long ere now. That the City of London should so long have been without that protection which statistics unquestionably prove to be invaluable, is anything but a creditable state of affairs. With whom the blame rests it is somewhat difficult to say, but we imagine that the heads of the Metropolitan Fire Department have been somewhat supine in the matter, and have shut their eyes to the actual value of fire telegraphs—a value which the experience of many years in countries other than our own, has completely proved to exist.

Had the fire insurance authorities thrown the weight of their influence into the scale, the state of affairs which existed would have long since been changed, but unfortunately the interests of the insurance companies do not appear to be advanced by such protective means, for a fire, which to many is a most disastrous occur-rence, is not by any means an ill wind to all concerned, for, as Mr. Bright stated, a good fire brings new insurers in shoals to the companies.

Mr. Bright not only considered the question of street telegraphs, but pointed out the importance of providing every room in a house with "thermostats," so that the existence of fire may be indicated in the shortest possible time. Considering the really trifling expense required to fit such apparatus, and their undoubted efficiency, it can only, we think, be ignorance which hinders the general public from employing them in their houses.

Mr. Treuenfeld's suggestion, that a committee should be formed by the Society of Telegraph Engineers, to consider and report upon the question of fire telegraphs, and communicate with the insurance companies, is worthy of every consideration. The subject is certainly of quite as much importance as that of lightning conductors, which the Society has already taken in hand.

The Distribution of Electricity.—It is rumoured, whether correctly or not we are unable to say, that the success of the lighting of the five stations on the Metropolitan Railway by means of the Gaulard-Gibbs "secondary generators" is such, that the directors of the railway company contemplate adopting the system for illuminating the rest of the underground stations.

ELECTRIC LAUNCHES.

ON the evening of the 16th ult., Mr. A. RECKENZAUN read a paper on "Electric Launches," before the members of the Society of Arts. At the meeting of the British Association in Southport, last year, Mr. Reckenzaun gave a similar paper, which was published in the ELECTRICAL REVIEW at the time. In his present lecture the author does not advance anything new, but treats the subject in a wider sense. We shall therefore only give the more important points brought forward by Mr. Reckenzaun. In speaking of the convenience of electrically-propelled vessels, the lecturer says :—

Nearly the whole space of a launch should be available for the accommodation of passengers, and this is the case with an electrically-propelled launch. We have it on good authority, that an electric launch will accommodate nearly double the number of passengers that a steam launch of the same dimensions would.

A further convenience arising from electromotive power is the absence of combustibles, and the absence of the products of combustion—matters of great importance; and for the milder seasons, when inland navigation is principally enjoyed, the absence of heat, smell, and noise, and, finally, the dispensing with one attendant on board, whose wages, in most cases, amount to as much or more than the cost of fuel, besides the inconvenience of carrying an additional individual. (Mr. Reckenzaun then goes on to describe Jacobi's apparatus, which was employed 45 years ago on the river Neva, and with which our readers are already acquainted.)

It may not be generally known that an electric launch was tried for experimental purposes on a lake at Penllegaer, near Swansea. Mr. Robert Hunt, in the discussion of his paper on electro-magnetism before the Institution of Civil Engineers in 1858, mentioned that he carried on an extended series of experiments at Falmouth, and at the instigation of Benkhausen, Russian Consul-General, he communicated with Jacobi upon the subject. In the year 1848, at a meeting of the British Association at Swansea, Mr. Hunt was applied to by some gentlemen connected with the copper trade of that part, to make some experiments on the electrical propulsion of vessels; they stated, that although electricity might cost thirty times as much as the power obtained from coal, it would, nevertheless, be sufficiently economical to induce its employment for the auxiliary screw ships employed in the copper trade with South America.

The boat at Swansea was partly made under Mr. (now Sir William) Grove's directions, and the engine was worked on the principle of the old toys of Ritchie, which consisted of six radiating poles projecting from a spindle, and rotating between a large electro-magnet. Three persons travelled in Hunt's boat, at the rate of three miles per hour. Eight large Grove's cells were employed, but the expense put it out of question as a practical application.

Professor Silvanus Thompson says that an electric boat was constructed by Mr. G. E. Dering, in the year 1856, at Messrs. Searle's yard, on the river Thames; it was worked by a motor in which rotation was effected by magnets arranged within coils, like galvanometer needles, and acted on successively by currents from a battery.

From a recent number of the *Annales de L'Electricitè*, we learn that Count de Moulins experimented on the lake in the Bois de Boulogne, in the year 1866, with an iron flat-bottomed boat, carrying twelve persons. Twenty Bunsen cells furnished the current to a motor on Froment's principle turning a pair of paddle wheels.

Until Trouvé's trip on the Seine, in 1881, and the launch of the *Electricity* on the Thames, in 1882, very little was known concerning the history of electric navigation.

M. Trouvé originally employed Planté's secondary battery, but afterwards reverted to a bichromate battery of his own invention. In all the primary batteries hitherto applied with advantage, zinc has been used as the acting material. Where much power is required, the consumption of zinc amounts to a formidable item; it costs, in quantity, about 3d. per pound, and in a well-arranged battery a definite quantity of zinc is transformed. The final effect of this transformation manifests itself in electrical energy, amounting to about 746 Watts, or one electrical horse-power for every two pounds of this metal consumed per hour. The cost of the exciting fluid varies, however considerably; it may be a solution of salts, or it may be dilute acid. Considering the zinc by itself, the expense for five electrical or four mechanical horse-power through an efficient motor, in a small launch, would be 2s. 6d. per hour. Many persons would willingly sacrifice 2s. 6d. per hour for the convenience, but a great item connected with the employment of zinc batteries is in the exciting fluid, and the trouble of preparing the zinc plates frequently. The process of cleaning, amalgamating and re-filling is so tedious, that the use of primary batteries for locomotive purposes is extremely limited. To re-charge a Bunsen, Grove, or bichromate battery, capable of giving six or seven hours' work at the rate of five electrical horse-power, would involve a good day's work for one man; no doubt he would consider himself entitled to a full day's wages, with the best appliances to assist him in the operation.

Several improved primary batteries have recently been brought out, which promise economical results. If the residual compound of zinc can be utilised and sold at a good price, then the cost of such motive-power may be reduced in proportion to the value of those by-products.

For the purpose of comparison, let us now employ the man

who would otherwise clean and prepare the primary cells, at engine-driving. We let him attend to a 6 horse-power steam-engine, boiler, and dynamo machine for charging 50 accumulators, each of a capacity of 370 ampère hours, or one horse-power hour. The consumption of fuel will probably amount to 40 lbs. per hour, which, at the rate of 18s. a ton, will give an expenditure of nearly 4d. per hour. The energy derived from coal in the accumulator costs, in the case of a supply of 5 electrical horse-power for 7 hours, 2s. 9d.; the energy derived from the zinc in a primary battery, supplying 5 electrical horse-power for 7 hours, would cost 17s. 3d.

In order that electric launches may prove useful, it will be desirable that charging stations should be established, and on many of the British and Irish rivers and lakes there is abundance of motive power, in the shape of steam or gas-engines, or even waterwheels.

A system of hiring accumulators ready for use may, perhaps, best satisfy the conditions imposed in the case of pleasure launches.

It is difficult to compile comparative tables showing the relative expenses for running steam launches, electric launches with secondary batteries, and electric launches with primary zinc batteries; but I have roughly calculated that, for a launch having accommodation for a definite number of passengers, the total costs are as 1, 2·5, and 12 respectively, steam being lowest and zinc batteries highest.

The accumulators are, in this case, charged by a small high-pressure steam-engine, and a very large margin for depreciation and interest on plant is added. The launch taken for this comparison must run during 2,000 hours in the year, and be principally employed in a regular passenger service, police and harbour duties, postal service on the lakes and rivers of foreign countries, and the like.

A complete Faure-Sellon-Volckmar cell, such as is used in the existing electric launches, weighs, when ready for use, 56 lbs.; and it stores energy equal to 1 horse-power for 1 hour = 1,980,000 foot-pounds, or about 1 horse-power per minute for each pound weight of material. It is not advantageous to withdraw the whole amount of energy put in; although its charging capacity is as much as 370 ampère hours, we do not use more than 80 per cent., or 300 ampère hours; hence, if we discharge these accumulators at the rate of 40 ampères, we obtain an almost constant current for 7½ hours; one cell gives an E.M.F. of 2 volts. In order to have a constant power of 1 horse for 7½ hours, at the rate of 40 ampères discharge, we must have more than 9 cells per electrical horse-power; and 47 such cells will supply 5 electrical horse power for the time stated, and these 47 cells will weigh 2,632 lbs.

We could employ half the number of cells by using them at the rate of 80 ampères, but then they will supply the power for less than half the time. The fact, however, that the cells will give so high a rate of discharge for a few hours, is, in itself, important, since we are enabled to apply great power if desirable; the 47 cells above referred to can be made to give 10 or 12 electrical horse-power for over two hours, and thus propel the boat at a very high speed, provided that the motor is adapted to utilise such powerful currents.

The above-mentioned weight of battery power—viz., 2,632 lbs., to which has to be added the weight of the motor and the various fittings—represents, in the case of a steam launch, the weight of coals, steam-boiler, engine, and fittings. The electro-motor capable of giving 4 horse-power on the screw shaft need not weigh 400 lbs. if economically designed; this, added to the weight of the accumulators, and allowing a margin for switches and leads, brings the whole apparatus up to about 28 cwt.

An equally powerful launch engine and boiler, together with a maximum stowage of fuel, will weigh about the same. There is, however, this disadvantage about the steam power, that it occupies the most valuable part of the vessel, taking away some eight or nine feet of the widest and most convenient part, and in a launch of 24 feet length, requiring such a power as we have been discussing, this is actually one third of the total length of the vessel, and one-half of the passenger accommodation; therefore, I may safely assert that an electric launch will carry about twice as many people as a steam launch of similar dimensions.

The drawing, fig. 1, represents an electric launch built by Messrs. Yarrow and Company, and fitted up by the Electrical Power Storage Company, for the recent Electrical Exhibition in Vienna. She made a great number of successful voyages on the river Danube during the autumn. Her hull is of steel, 40 feet long and 6 feet beam, and there are seats to accommodate 40 adults comfortably. Her accumulators are stowed away under the floor, so is the motor, but owing to the lines of the boat, the floor just above the motor is raised a few inches. This motor is a Siemens D_2 machine, capable of working up to 7 horse-power with 80 accumulators.

In speaking of the horse-power of an electro-motor, I always

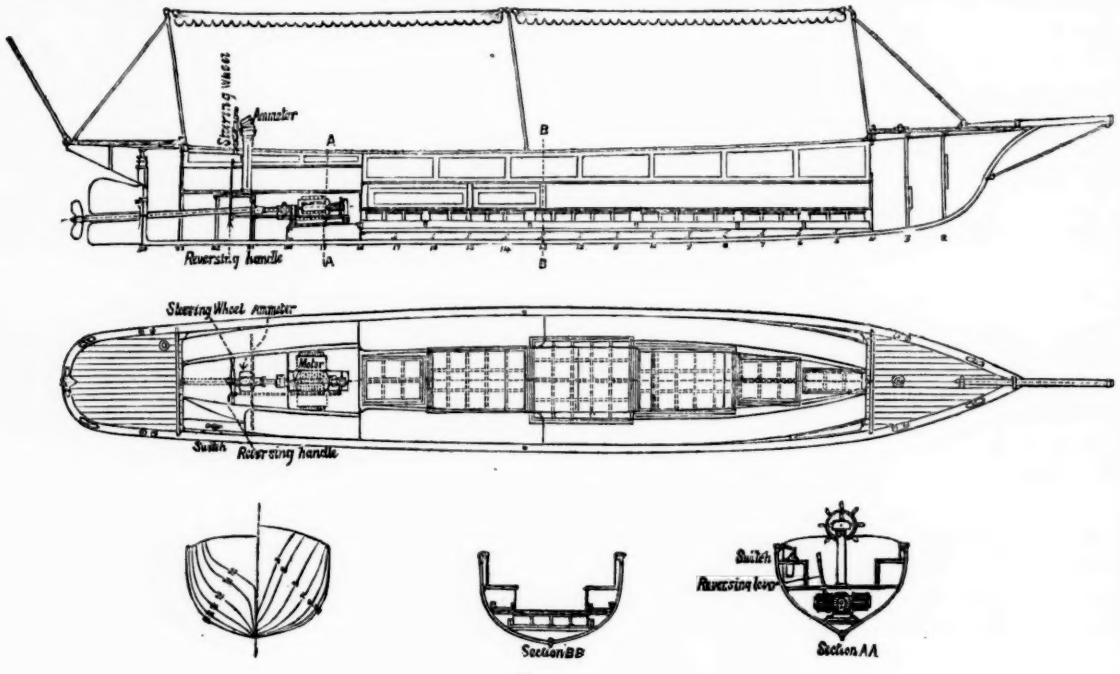

FIG. 1.

mean the actual power developed on the shaft, and not the electrical horse-power; this, therefore, should not be compared to the indicated horse-power of a steam-engine.

Comparing the relative weights of the steam-power and the electric-power for this launch, we find that they are nearly equal, each approaches 50 cwt.; but in the case of the steam launch we include 10 cwt. of coals, which can be stowed into the bunkers, and which allow fifteen hours' continuous steaming, whereas the electric energy stored up will only give us seven and a-half hours with perfect safety.

I have here allowed 8 lbs. of coal per indicated horse-power per hour, and 10 horse-power giving off 7 mechanical horse-power on the screw shaft; this is an example of an average launch engine. There are launch engines in existence which do not consume one-half that amount of fuel, but these are so few, so rare, and so expensive, that I have neglected them in this account.

Our present accumulator supplies 33,000 foot-pounds of work per pound of lead, but theoretically one pound of lead manifests an energy equal to 360,000 foot-pounds in the separation from its oxide; and in the case of iron, Prof. Osborne Reynolds told us in this place, the energy evolved by its oxidation is equivalent to 1,900,000 foot-pounds per pound of metal.

Theoretically then, with our weight of fully oxidised lead, we should be able to travel for 82 hours; with the same weight of iron for 430 hours, or 18 days and nights continually, at the rate of 8 miles per hour, with one charge. Of course, these feats are quite impossible. We might as well dream of getting 5 horse-power out of a steam-engine for one pound of coal per hour.

With dynamo machines the aim has been to obtain as nearly as possible as much electrical energy out of the machine as has been put in by the prime mover, irrespective of the quantity of

material employed in its construction. Dr. J. Hopkinson has not only improved upon the Edison dynamo, and obtained 94 per cent. of the powers applied in the form of electrical energy, but he got 50 horse-power out of the same quantity of iron and copper where Edison could only get 20 horse-power—and, though the efficiency of this generator is perfect, it could not be called an efficient motor, suitable for locomotion by land or water, because it is still too heavy. An efficient motor for locomotion purposes must not only give out in mechanical work as nearly as possible as much as the electrical energy put in, but it must be of small weight, because it has to propel itself along with the vehicle, and every pound weight of the motor represents so many foot-pounds of energy used in its own propulsion; thus, if a motor weighed 660 pounds, and were travelling at the rate of 50 feet per minute, against gravitation, it would expend 33,000 foot-pounds per minute in moving itself, and although this machine may give 2 horse-power, with an efficiency of 90 per cent., it would, in the case of a boat or a tram-car, be termed a wasteful machine. Here we have an all important factor which can be neglected, to a certain extent, in the dynamo as a generator, although from an economical point of view, excessive weight in the dynamo must also be carefully avoided.

The proper test for an electro-motor, therefore, is not merely its efficiency, or the quotient of the mechanical power given out, divided by the electrical energy put in, but also the number of feet it could raise its own weight in a given space of time, with a given current, or, in other words, the number of foot-pounds of work each pound weight of the motor would give out.

The Siemens D_2 machine, as used in the launch shown, is one of the lightest and best motors, it gives 7 horse-power on the shaft, with an expenditure of 9 electrical horse-power, and it weighs 658 lbs.; its efficiency, therefore, is 7-9ths, or nearly 78 per cent.; but its "co-efficient" as an engine of locomotion is 351—that is to say, each pound weight of the motor will yield 351 foot-pounds on the shaft. We could get even more than 7 horse-power out of this machine, by either running it at an excessive speed, or by using excessive currents; in both cases, however, we should shorten the life of the apparatus.

With a given energy expressed in watts, we can arrange a quantity of wire and iron to produce a certain quantity of work; the smaller the quantity of material employed, and the larger the return for the energy put in, the greater is the total efficiency of the machine.

Powerful electro-magnets, judiciously arranged, must make powerful motors. The ease with which powerful electro-magnets can be constructed, has led many to believe that the power of an electro-motor can be increased almost infinitely, without a corresponding increase of energy spent. The strongest magnet can be produced with an exceedingly small current, if we only wind sufficient wire upon an iron core. An electro-magnet excited by a tiny battery of 10 volts, and, say, one ampère of current, may be able to hold a tremendous weight in suspension, although the energy consumed amounts to only 10 watts, or less than 1-75th of a horse-power; but the suspended weight produces no mechanical work. Mechanical work would only be done if we discontinued the flow of the current, in which case the said weight would drop; if the distance is sufficiently small, the magnet could, by the application of the current from the battery, raise the weight again, and if that operation is repeated many times in a minute, then we could determine the mechanical work performed. Assuming that the weight raised is 1,000 lbs., and that we could make and break the current two hundred times a minute, then the work done by the falling mass could, under no circumstances, equal 1-75th of a horse-power, or 440 foot-pounds; that is, 1,000 lbs. lifted 2·27 feet high in a minute, or about one-eighth of an inch for each operation; hence the mere statical pull, or power of the magnet, does in no way tend to increase the energy furnished by the battery or generator, for the instant we wish to do work we must have motion—work being the product of mass and distance.

Large field-magnets are advantageous, and the tendency in the manufacture of dynamo machines has been to increase the mass of iron, because with long and heavy cores and pole pieces there is a steady magnetism ensured, and therefore a steady current, since large masses of iron take a long time to magnetize and demagnetize; thus very slight irregularities in the speed of an armature are not so easily perceived. In the case of electro-motors these conditions are changed. In the first place, we assume that the current put through the coils of the magnets is continuous; and secondly, we can count upon the momentum of the armature, as well as the momentum of the driven object, to assist us over slight irregularities. With electric launches we are bound to employ a battery current, and battery currents are perfectly continuous—there are no sudden changes; it is consequently a question as to how small a mass of iron we may employ in our dynamo as a motor without sacrificing efficiency. The intensity of the magnetic field must be got by saturating the iron, and the energy being fixed, this saturation determines the limit of the weight of iron. Soft wrought iron, divided into the largest possible number of pieces, will serve our purpose best. The question of strength of materials plays also an important part. We cannot reduce the quantity and division to such a point that the rigidity and equilibrium of the whole structure is in any way endangered.

The armature, for instance, must not give way to the centrifugal forces imposed upon it, nor should the field magnets be so flexible as to yield to the statical pull of the magnetic poles. The compass of this paper does not permit of a detailed discussion of the essential points to be observed in the construction of electro-motors; a reference to the main points, may, however, be useful. The designer has, first of all, to determine the most effective positions of the purely electrical and magnetic parts; secondly, compactness and simplicity in details; thirdly, easy access to such parts as are subject to wear and adjustment; and, fourthly, the cost of materials and labour. The internal resistance of the motor should be proportioned to the resistances of the generator, and the conductors leading from the generator to the receiver.

The insulation resistances must be as high as possible; the insulation can never be too good. The motor should be made to run at that speed at which it gives the greatest power with a high efficiency, without heating to a degree which would damage the insulating material.

Before fixing a motor in its final position, it should also be tested for power with a dynamometer, and for this purpose a Prony brake answers very well.

An ammeter inserted in the circuit will show at a glance what current is passing at any particular speed, and volt-meter readings are taken at the terminals of the machine, when the same is standing still as well as when the armature is running, because the E.M.F. indicated when the armature is at rest alone determines the commercial efficiency of the motor, whereas the E.M.F. developed during motion varies with the speed until it nearly reaches the E.M.F. in the leads; at that point the theoretical efficiency will be highest.

Calculations are greatly facilitated, and the value of tests can be ascertained quickly, if the constant of the brake is ascertained; then it will be simply necessary to multiply the number of revolutions and the weight at the end of the lever by such a constant, and the product gives the horse-power, because, with a given Prony brake, the only variable quantities are the weight and the speed. All the observations, electrical and mechanical, are made simultaneously. The electrical horse-power put into the motor is found by the well-known formula $C \times E \div 746$; this simple multiplication and division becomes very tedious and even laborious if many tests have to be made in quick succession, and to obviate this trouble, and prevent errors, I have constructed a horse-power diagram, the principle of which is shown in the diagram (fig. 2).

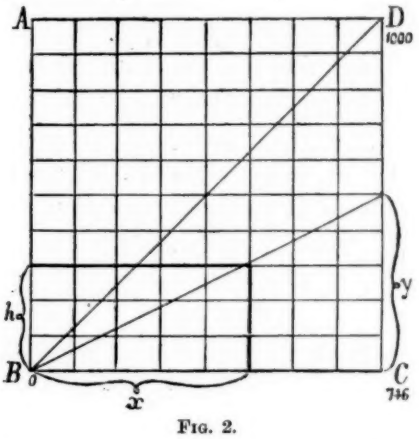

FIG. 2.

Draw a square, A, B, C, D—divide, B, C, into 746 parts, and C, D, into 1,000 parts, or generally, let a division on C, D be 746 of a division on B, C, so that we can use the horizontal lines, cutting A, B, as a horse-power scale. A, B, in the above diagram, gives 1,000 horse-power, if the line, B, C, represents 746 volts, and C, D, 1,000 ampères. Let x = any number of volts, y the ampères, and h the horse-power, then

$$\frac{h}{x} = \frac{y}{746} \therefore h = \frac{xy}{746}.$$

A fine wire or thread stretched from o as a centre to the required division on C, D, will facilitate references,

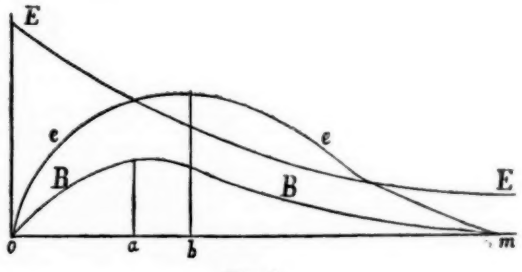

FIG. 3.

Graphic representations are of the greatest value in all comparative tests. Mr. Gisbert Kapp has recently made known a useful curve, by means of which one can easily compare the power and efficiency at a glance. (Fig. 3.)

The speeds are plotted as abscissæ, and the electrical work absorbed in watts divided by 746 as ordinates; then with a series-wound motor we obtain the curve, E, E. The shape of this curve depends on the type of the motor. Variation of speed is obtained by loading the brake with different weights. We begin with an excess of weight which holds the motor fast, and then a maximum

current will flow through it without producing any external work. When we remove the brake altogether, the motor will run with a maximum speed, and again produce no external work, but in this case very little current will pass; this maximum speed is, *o*, *m*, on the diagram. Between these two extremes external work will be done, and there is a speed at which this is a maximum. To find these speeds we load the brake to different weights, and plot the resulting speeds and horse-powers as abscissæ and ordinates producing the curve, B B. Another curve, $e = \frac{B}{E}$, made with an arbitrary scale, gives the commercial efficiency; the speed for a maximum external horse-power is *o*, *a*, and the speed for the highest efficiency is represented by *o*, *b*. In practice it is not necessary to test a motor to the whole limits of this diagram, it will be sufficient to commence with a speed at which the efficiency becomes appreciable, and to leave off with that speed which renders the desired power.

I have now to draw your attention to a new motor of my own invention, of the weight of 124 lbs., which, at 1,550 revolutions, gives 31 ampères and 61·5 volts at terminals. The mechanical horse-power is 1·37, and the coefficient 373.

	Ohms.
Armature resistance	·4*w*.
Field-magnet resistance	·17*w*.
Insulation resistance	1,500,000*w*.

This motor was only completed on the morning before reading the paper; it could not, therefore, be tested as to its various capacities.

We have next to consider the principle of applying the motive power to the propulsion of a launch. The propellers hitherto practically applied in steam navigation are the paddle-wheel and the screw. The experience of modern steam navigation points to the exclusive use and advantage of the screw propeller where great speed of shaft is obtainable, and the electric engine is pre-eminently a high-speed engine, consequently the screw appears to be most suitable to the requirements of electric boats. By simply fixing the propeller to the prolonged motor shaft, we complete the whole system, which, when correctly made, will do its duty in perfect order, with an efficiency approaching theory to a high degree.

Whatever force may be imparted to the water by a propeller, such force can be resolved into two elements, one of which is parallel, and the other in a plane at right angles to the keel. The parallel force alone has the propelling effect; the screw, therefore, should always be so constructed that its surfaces shall be chiefly employed in driving the water in a direction parallel to the keel from stem to stern.

It is evident that a finely pitched screw, running at a high velocity, will supply these conditions best. With the beautiful screw made by Messrs. Yarrow, 95 per cent. of efficiency have been obtained when running at a speed of over 800 revolutions per minute, that is to say, only 5 per cent. was lost in slip.

Reviewing the various points of advantage, it appears that electricity will, in times to come, be largely used for propelling launches, and, perhaps, something more than launches.

Discussion.

The Chairman, Mr. W. H. PREECE, F.R.S., in inviting discussion, said that no doubt those present would like to know something about the cost of such a boat as Mr. Reckenzaun described, and he hoped that gentleman would give them some information on that point.

Admiral SELWYN suggested that electrical propulsion would be specially applicable to lifeboats. A lifeboat must be expected at times to capsize, and very often to be full of water, which rendered a steam-boiler an impossibility, but perhaps something might be done with electricity. Chemists would agree with him that iron and several other metals could be used for this purpose, some of which combined lightness with the capacity for complete oxidation, and some of which would probably be used in future. But with all that possibility he thought Mr. Reckenzaun was a little below the mark when he talked about the dream of getting 5 horse-power for one pound, he would not say of coal, but of fuel. For some months he had seen one-sixth lb. of fuel produce 1 horse-power, and he knew it could be done. That fuel was condensed concentrated fuel in the shape of oil. In a railway train weight was a formidable affair, but in a floating vessel it was still more important. He did not think, however, that a light secondary battery was by any means an impossibility. Mr. Loftus Perkins had actually produced, by improvements in the boiler and steam-engine, two great things; first, one indicated horse-power for a pound of fuel per hour, and next he had devised a steam-engine of 100 horse-power, of a weight of only 84 lbs. per horse-power, instead of 304 lbs., which was about the average.

Lord SUDELEY thought that in the future there would be a very great opening for such boats, depending, no doubt, in great measure on what could be done with secondary batteries, in which there was, as yet, great room for improvement. Then, again, there was the question how far they could be used, unless there were conveniences at different places for charging, or re-charging them. Another important question was, how far these boats could be used in harbour defences, or in torpedo warfare, which would be a great boon, on account of the large amount of space at disposal.

Mr. CROHNE (Messrs. Yarrow) said he had the highest opinion of this launch, having carried through the experiments. It was very convenient and pleasant; there was no noise, dirt, or vibration, and in every respect he considered it with great respect. One very important point in connection with this boat was, that the weight was so low down as to ballast her in the most perfect manner, such as could not be attained in any steamer. The accommodation was very great, and the stability enormous. In the case of a life-boat, the weight being so low down would be of the greatest service; in fact, it would be almost impossible to capsize the boat. He was afraid there was no chance of using such boats for torpedo warfare, torpedo boats being cram-full of steam-power; one of that size, for instance, would be about 100 indicated horse-power; and he did not know how 70 actual horse-power was to be got from electricity in the weight such a boat would carry.

Lieut.-Colonel WEBBER thought the allusion made by Lord Sudeley to the use of this sort of launch for torpedo purposes was not intended to refer to the so-called torpedo boats mentioned by Mr. Crohne, having a very high speed, but rather to the advantage of having a boat with the large space, such as was here afforded, for the purpose of laying out torpedoes for the defence of harbours. Besides the advantage of a large space, it would allow of a smaller boat being used, which was of great importance, as all would recognise who had been engaged in this service. Again, when torpedoes had to be laid out at night in the neighbourhood of an enemy, the silence, and the absence of glare and reflection from the funnel, would be of the highest advantage.

Mr. CRAMPTON said he did not think steam could ever compete with electricity, under certain circumstances; but, at the same time, it would be a long time before it was superseded. He should like very much to see the compressed oil, one-sixth of a pound of which would give 1 horse-power per hour.

Admiral SELWYN said he had seen a common Cornish boiler doing it years ago.

Mr. CRAMPTON said it had never come under his notice, and he had no hesitation in saying that no such duty ever was performed by any oil, because he never heard of any oil which evaporated more than 18 to 22 lbs. of water per lb.

The CHAIRMAN asked if he rightly understood Admiral Selwyn that he had recently seen an invention in which one-sixth of a pound of condensed fuel would give 1 horse-power per hour.

Admiral SELWYN said it was now some years ago since he saw this thing going on, but the persons who did it did not know how or why it was done. He had studied the question for the last ten years, and now knew the *rationale* of it, and would be prepared shortly to publish it. He knew that 22 was the theoretical calorific value of the pound of oil, and never supposed that oil alone would give 46 lbs., which he saw it doing. He had found out that by means of the oil forming carbon constantly in the furnace, the hydrogen of the steam was burned, and that it was a fallacy to suppose that an equal quantity of heat was used in raising steam, at a pressure of, say, 120 lbs. to the square inch, as the hydrogen was capable of developing when properly burned. There were, however, conditions under which alone that combustion could take place—one being that the heat of the chamber must be 3,700°, and that carbon must be constantly formed.

Mr. Gümpel said it was not so much the present position of the electric launch, as its promise for the future, which was of interest and importance. One point to which he would call attention was the great speed of the propeller. It had about 9 inches pitch, and worked at 800 revolutions a minute. He believed that if Mr. Reckenzaun could construct a motor which would give a less number of revolutions, but develop the same amount of propelling power, there would be greater efficiency. With regard to the general application of electricity to the propulsion of vessels as well as to railway trains, he believed that many of those present would live to see electricity applied to that purpose, because there were so many minds now applied to the problem, that before long he had no doubt we should see coal burned in batteries, as it was now burned in steam boilers. The utmost they could do, then, would be about 50 per cent. less than Admiral Selwyn said could be accomplished with condensed fuel. He could not but wonder where Admiral Selwyn obtained his information, knowing that a theoretically perfect heat-engine would only give 23 per cent. of the absolute heat used, and that a pound of the best coal would give but 8,000 and hydrocarbon 13,000 heat units, whilst hydrogen would give 34,000, and calculating it out, how was it possible to get out of one-sixth of a pound of carbon, or any hydrocarbon, the amount of power stated. No doubt, when Admiral Selwyn applied the knowledge which physicists would give him of the amount of power which could be got out of a certain amount of carbon and hydrogen, he would find that there was a mistake made somewhere. He greatly admired the manner in which Mr. Reckenzaun had brought forward the subject, which formed a pleasant contrast to some papers they had heard from inventors of particular motors; and he thought it would be very useful if he would prepare another paper on the different forms of motors, and the conditions necessary for their efficiency.

Mr. RECKENZAUN, in reply, said it would be very difficult to answer the question put by the chairman, as to the cost of an electric launch—quite as difficult as to say what would be the cost of a steam launch. It depended on the fittings, the ornamental part, the power required, and the time it was required to run. If such a launch were to run constantly, two sets of accumulators would be required, one to replace the other when discharged. This could be easily done, the floor being made to take up, and the cells could be changed in a few minutes with proper appliances. As to Admiral Selwyn's remarks about one-sixth of a pound of fuel per horse-power, he had never heard of such a thing before, and should like to know more about it. Mr. Loftus

Perkin's new steam-engine was a wonderful example of modern engineering. A comparatively small engine, occupying no more space than that of a steam launch of considerable dimensions, developed 800 horse-power indicated. From a mechanical point of view, this engine was extremely interesting; it had four cylinders, but only one crank and one connecting rod; and there were no dead centres. The mechanism was very beautiful, but would require elaborate diagrams to explain. Mr. Perkins deserved the greatest praise for it, for in it he had reduced both the weight of the engine and the consumption of fuel to a minimum. He believed he used coke, and took one pound per horse-power. He should not like to cross the Channel in the electric launch, if there was a heavy sea on, for shaking certainly did not increase the efficiency of the accumulators, but a fair amount of motion they could stand, and they had run on the Thames, by the side of heavy tug-boats causing a considerable amount of swell, without any mishap. Of course each box was provided with a lid, and the plates were so closely packed that a fair amount of shaking would not affect them; the only danger was the spilling of the acid. Mr. Crohne had remarked that a torpedo boat of that size would have 100 indicated horse-power, but then the whole boat would be filled with machinery. What might be done with electricity, they had, as yet, no idea of. At present, they could only get 33,000 foot pounds from 1 lb. of lead and acid, though, theoretically, they ought to get 360,000 foot-pounds. Iron, in its oxidation, would manifest theoretically 1,900,000 foot-pounds per lb. of material. As yet they had not succeeded in making an iron accumulator; if they could, they would get about six or seven times the energy for the same weight of material, or could reduce the weight proportionately for the same power, and in that way they might eventually get 70-horse-power in a boat of that size, because the weight of the motor was not great. With regard to the formation of a film on the surface, no doubt a film of sulphate of lead was formed if the battery stood idle, but it did not considerably reduce its efficiency; as soon as it was broken through by the energy being evolved from it, it would give off its maximum current. They knew by experience that, with properly constructed accumulators, 80 per cent. of the energy put into them was returned in work. With regard to Mr. Gümpel's remark on the propeller, he would say that it was constructed to run 900 revolutions; if it were driven by a steam-engine, and the speed reduced to 300, not only would the pitch have to be altered, but the surface would have to be larger, which would entail more friction. Mr. Crohne would bear him out that they lost only 5 per cent. by slip and friction combined, on an average of a great number of trials, both with and against the current.

Mr. Gümpel remarked that Sir E. J. Reed had pointed out in that room that it was a fallacy to suppose that slip in itself was a loss. You must have slip for the purpose of propelling the vessel. The 5 per cent. loss would not give any idea of the efficiency of the propellor in itself.

Mr. CROHNE said he had always been of opinion that such a fine pitch would not do at all, and they had an electric launch made with gear to reduce the speed of the propeller; but, practically, he found he was mistaken. He had expected that negative slip and the friction of the propeller would be a serious impediment, but he found he was entirely mistaken. This wonderfully fine pitch of about 10 inches, and a diameter of 20 inches, was quite unknown before, as far as he was aware, but it gave very good results indeed.

The CHAIRMAN, in proposing a vote of thanks to Mr. Reckenzaun, said he rejoiced to find that that gentleman had proved, to one practical man at least, that his views had been mistaken. He found in these days of the practical applications of electricity, that the ideas of most practical men were gradually being proved to be mistaken, and every day new facts were being discovered, which led them to imagine that as yet they were only on the shore of an enormous ocean of knowledge. It was quite impossible to say what these electric launches would lead to. Enormous strides were being made with regard to secondary batteries. No one present had been a greater sceptic with regard to them at first than he himself; but after constant experiments—employing them, as he had done for many months, for telegraphic purposes—he was gradually coming to view them with a much more favourable eye. He must congratulate Mr. Reckenzaun on the excellent diagrams he had constructed. The trouble of calculating figures of this sort was very great when making experiments; and the use of diagrams and curves expedited the labour very much. At present they were passing through a stage of electrical depression; robbery had been committed on a large scale; the earnings of the poor had been filched out of their pockets by sanguine company promoters; an enormous amount of money had been lost, and the result had been that confidence was, to a great extent, destroyed. But those who had been wise enough to keep their money in their pockets, and to read the papers read in that room, must have seen that there was a constant steady advance in scientific knowledge of the laws of electricity and in their practical applications, and as soon as some of these rotten mushroom companies had been wiped out of existence, they might hope that real practical progress would be made, and that the day was not far distant when the public would again acquire confidence in electrical enterprise. They would then enable inventors and practical men to carry out their experiments, and to put electrical matters on a proper footing.

Apropos of the discussion on Mr. Reckenzaun's paper, Mr. Gümpel writes to the *Society of Arts Journal* to the following effect:—

The many erroneous statements made in the daily and weekly papers with regard to the efficiency of primary batteries induces me to send the following figures relating to the quantity of fuel required to produce 1 horse-power per hour by means of steam and by electricity. Perhaps these figures may be thought of sufficient interest for insertion in your next issue.

		Foot-pounds.
1 Heat-unit	(Fahrenheit) ..... =	772
Ditto	(Centigrade) ..... =	1,390
1 Horse-power	per minute ..... =	33,000
Ditto	per hour ..... =	1,980,000

Ditto ditto in heat-units—

$$\frac{1,980,000}{1,390} = 1,425$$

Heat-units (Centigrade) contained in—

1 lb. of coal	= 8,000
1 lb. of hydrocarbon (liquid)	= 11,000 (about)
1 lb. of hydrogen	= 34,000

Assuming, with Prof. Adams (see opening address at the Society of Telegraph Engineers and Electricians), the greatest efficiency of a theoretically perfect heat-engine to be = 23 per cent., we have—

For coal	23 per cent. of	8,000	= 1,840
For hydrocarbon	„ „	11,000	= 2,530
For hydrogen	„ „	34,000	= 7,820

Hence 1 horse-power requires for its development in such a theoretically perfect engine at least—

$$\frac{1,425}{1,840} = 0{\cdot}774 \text{ lb. of carbon,}$$

$$\text{or } \frac{1,425}{2,530} = 0{\cdot}563 \text{ lb. of hydrocarbon,}$$

$$\text{or } \frac{1,425}{7,820} = 0{\cdot}182 \text{ lb. of hydrogen.}$$

The efficiency of a perfect voltaic battery and electric motor may, at the lowest estimate, be assumed as 90 per cent.

1 lb. of zinc = 1,300 J; 90 per cent. = 1,170.

One horse-power developed in an electric motor by a current from a voltaic battery requires hence at least—

$$\frac{1,425}{1,170} = 1{\cdot}133 \text{ lbs. of zinc.}$$

The above will elucidate the assertion about 1 horse-power being produced by 0·166 lbs. of hydrocarbon, against the lowest possible 0·563 lbs.; but it also shows Mr. Reckenzaun's modest estimate of 2 lbs. of zinc per horse-power per hour in its proper light.

I may here add that D'Arsonval (see *La Lumière Electrique*, vol. v., p. 90) has obtained with a consumption of 1·42 lbs. of zinc 1 horse-power per hour.

A "MAGNETIC BALANCE."

DURING the past month Professor D. E. Hughes, F.R.S., laid before the Institution of Mechanical Engineers a paper on "The Physical Condition of Iron and Steel." The substance of this interesting communication is embodied in a former paper of the Professor's, published in the ELECTRICAL REVIEW for Dec. 29th, 1883. The apparatus with which the experiments were carried out was there briefly described, but we are now enabled to give a general view and plan of the instrument which Professor Hughes calls a "magnetic balance." Fig. 1 shows the complete balance, and fig. 2 illustrates the plan and connections of its various parts. The instrument consists of a delicate magnetic needle, A, fig. 2, suspended by a silk fibre; it is 5 centimetres in length (2 in.), and its pointer rests near an index having a single fine black mark for its zero. The movement of the needle on either side of zero is limited to 5 millimetres (0·2 in.) by means of ivory stops or projections. When the north end of the needle and its zero index are north, the needle rests parallel with its index; but the slightest external influence, such as a piece of iron 1 millimetre in diameter (0·04 in.), placed at 10 centimetres distance (4 in.) deflects the needle to the right or left, according to the polarity of its magnetism, and with a force proportionate to its magnetic power. If we place on the opposite side of the needle, and at the same distance, a wire possessing absolutely the same polarity, of similar name and force, the two balance each other, and the needle returns to zero; and if we know the magnetic value required to balance the first piece of iron, we know the magnetic value of both.

The iron, B, (which may be in the form of wires, rods,

bars, plates, or any shape or size desired),* is placed at a fixed distance—preferably 10 or more centimetres (4 in.)—resting against a fixed brass stop, C. The centre of the iron should be in a line with the centre of the needle, and it should be placed at right angles to the needle, lying horizontally east and west, so as to be free from the directing influence of the earth's magnetism.

The compensator, placed upon the opposite side of of the needle, and at a distance of 30 centimetres (12 in.) consists of a powerful steel bar-magnet, D, 3 centimetres width, 1 centimetre thick, and 6 centimetres long (1·18 × 0·4 × 2·36 in.). This turns upon its axis, carrying with it the pointer, E, to indicate its degree of angular deplacement on the graduated circle. Generally this bar-magnet is parallel with the needle, the pointer of the compensator and the needle being at

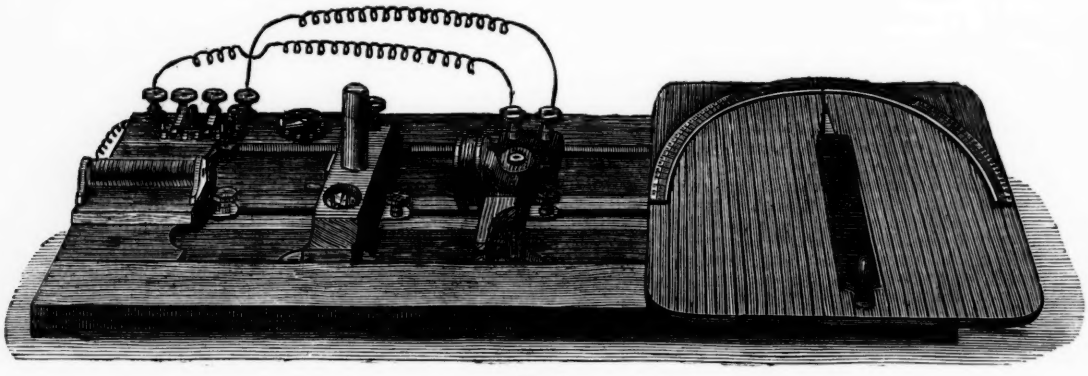

FIG. 1.

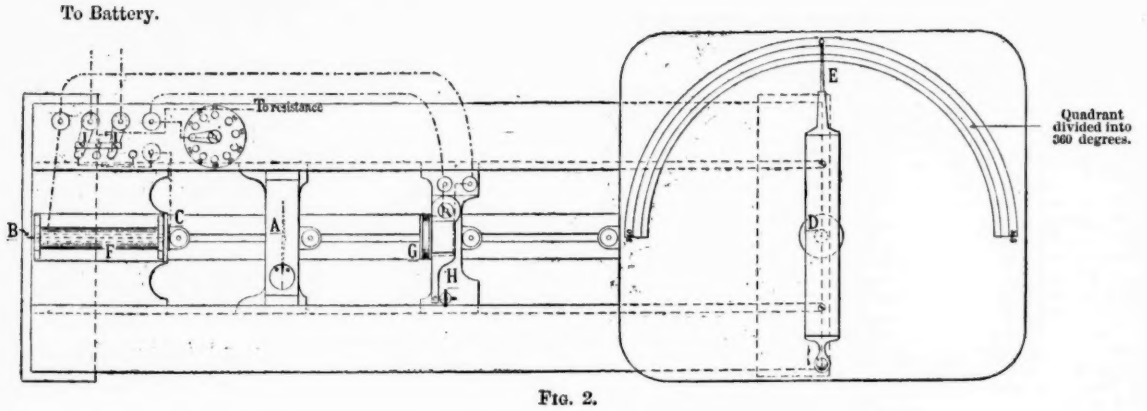

FIG. 2.

zero ; but when we wish to measure the amount of magnetism in the piece of iron, B, the bar-magnet is made to pass through an angular displacement necessary to balance this force, and its index readings on the graduated circle are taken as the comparative values.

In order to magnetise the iron, B, if required, by an electrical current, a coil of insulated copper wire, F, is placed near C, the iron then becoming the core of an electro-magnet.

Now as this coil, independently of its iron, acts upon the needle, this action must be balanced by an opposing coil, G, on the opposite side. The position and power of these two coils can be adjusted by means of the lever, H, which allows us to find a position where the two coils completely neutralise each other. If we introduce iron in the coils on either side the balance is destroyed, and we have solely the magnetic influence of the iron core, whose value we find by an equal opposing magnetism brought into play by the rotating magnetic compensator, D.

A reversing key, I, serves to change the direction of the current, and thus any difference between north and south polarity in the iron core can be observed. One Daniell cell is all that is required as a battery ; but great care must be taken that its electromotive force is a constant, otherwise all variations in the battery would be read as variations in the quality of the iron itself ; and we need in addition a series of resistance coils from 10 to 100 ohms, in order to reduce the current sufficiently to bring the whole series, from soft Swedish iron to cast steel, into range. Separate and finer determination can then be separately made by an extremely weak force for soft iron, and full or increased battery power for tempered steel. A series of different sized coils to replace F is necessary whenever we vary greatly the diameter of the core. The first size, with an internal core-opening of one centimetre (0·4 in. will test bars and rods of wire, from one centimetre diameter to the finest needle ; but for larger bars, plates, &c., coils must be used which allow free passage for the iron into the core. Great care and some practice is necessary in the use of the instrument, so as to ensure that the iron is placed in a neutral field ; but when we have really obtained the necessary conditions we can take several readings in a single minute, with an invariable result for the same kind of iron.

All irons and steel have some traces of remaining magnetism ; it is therefore necessary that a double reading (north and south) should be taken by means of reversed currents. In this case the quadrant is divided into 360° on each side of zero ; and the total value of north and south polarity added together is that given in the tables of magnetic capacity.

* The smallest rods yet tested have been fine sewing needles, and the largest bars of 5 centimetres (0·2 in.) diameter, 1 metre (3 ft. 3⅜ in.) long.

Several methods of observation can be employed with the magnetic balance, the usual one being that already described; but there are many others, such as magnetising all specimens to the same value and noting the amount of current required. We may also observe the remaining magnetism after the cessation of the current; the influence of a weak current after the passage of a strong, &c. Many of these methods give interesting facts, particularly useful to those making researches upon the cause of magnetism.*

By means of this instrument the Professor has tested sixty brands of iron and steel, mostly in the form of wires. A wire one millimetre diameter and ten centimetres long (0·04 inches and 4 in.) was the standard size used, as we can more readily temper small wires than large rods. In all comparative experiments between iron of different grades we must have one standard form, to which all the rest must be similar in form and size. Thus, we could not compare a square or flat bar with a piece of wire; but if all pieces have the same form, then any difference observed between them must be due to their comparative softness, from which we can deduce the quality and place of each on the line ranging from soft iron to cast steel.

Dividing Line Between Iron and Steel.

Mechanical tests, as well as chemical analyses, have failed to find any distinct line of separation between the numerous varieties of iron and steel. The physical method which Professor Hughes has employed shows clearly that there is no dividing line between iron and steel. We have a continuous series from the softest iron to the hardest steel, and between them we have every variety of intermediate quality. In point of fact the sixty brands which have been tested fill up all the gaps: and by their means we could choose iron gradually hardening into steel, or steel gradually softening into iron. Thus ordinary iron is physically a soft steel, and steel a hard iron. All are hardened by temper; all are hardened by mechanical treatment, as hammering and rolling; all are hardened by strains and stresses of any nature whatever; the difference though large, is only in degree. At the extreme end towards iron, mechanical hardening has a greater effect than tempering. At the steel end, tempering has a greater effect than mechanical hardening. We might here suppose we could find a physical dividing line: but some mild steels have been found to stand just on that dividing line, which had previously appeared the most satisfactory. We are thus forced to adopt an arbitrary line. Neither the mechanical nor physical methods will suffice to overcome the difficulty. Mechanically a certain tensile strength has been proposed—the objection to which is that unless we take note of the physical conditions (such as whether soft, tempered, &c.) we shall have very different magnetic readings for what would stand as the same material. The addition of the ultimate elongation might to some extent weaken this objection, but would not remove it. The physical method would allow us to fix upon a certain molecular rigidity, or difference in the readings of the same metal annealed and tempered, as the boundary; it would have however all the objection of being a purely arbitrary line. Chemical analysis also fails to show a dividing line, as the same proportion of carbon is accompanied by very different physical results, if sulphur, phosphorus, &c., are present. In the researches of Professor Hughes, he has adopted the plan of simply reading an unknown piece of iron or steel in its annealed stated: if the figure stands above 400° it is classed as iron, if below as mild or hard steel, according to its magnetic capacity. This happens to agree with the general classification at present in use, and suffices as a general division.

Relations of Physical Forces in Iron and Steel.

Iron is by far the richest of all metals in its physical nature. It stands almost alone in its magnetic qualities, as well as in its tempering properties, and, while there is an evident relation between capacity for temper and loss of magnetism when tempered, so these experiments show an intimate if not absolute relation between the electrical conductivity of iron, and its magnetic capacity. In Table IV*., in the column of electrical resistance as given by Messrs. Smith & Co., we find a progressive increase of resistance, just as we find a progressive decrease in magnetic capacity, and there is an exact correspondence between the two variations. The molecular rigidity, observed by the author as the cause of hardness, gives at once decreased magnetic capacity, and increased electrical resistance, so that from the magnetic capacity we might deduce its electrical resistance, and *vice versa*. A very remarkable phenomena is that this only holds true in the limited sphere of elastic rotation, which the author has already described.

This demonstration the author believes to be of great theoretical value, and in a future paper, upon the theory of magnetism, its importance will be shown.

Another extraordinary relation of physical to mechanical tests may be mentioned. In Table IV.* the tensile strength bears no relation either to the magnetic or electric qualities. On increasing the electromotive force in the magnetic balance, all the readings became confused; there was no longer any fixed relation as to hardness, nor any other quality. But on again forcing the magnetism to a very high point, the figures for magnetic capacity were found to bear exactly the same relation to each other as those for tensile strength. This however may have been only an accident, as it only seems true at present in relation to the wires in Table IV.*; but it gives hope that by a new method we may some day be enabled, not only to deduce electrical conductivity from magnetic capacity, but also tensile strength. Already in Table IV.* we notice a close relation between molecular rigidity, as indicated by the figures for the annealed wires, and tensile strength.

Leaving aside all theoretical considerations and hoped for improvements in the methods of observation, the author believes that he has demonstrated clearly that, by the aid of the instrument and methods described, we can at once determine the physical state of iron, as influenced by tempering and mechanical hardening, from the ultimate degree of softness to that of hardness: that we can at once determine the best iron for electromagnets, and the best methods of softening it, as well as the best steel for permanent magnets, and the best temper to be given to it. He therefore ventures to hope that the Magnetic Balance will prove an aid of no small value in all researches into the physical state of iron and steel.

* The author has not patented this instrument, giving it freely to the scientific and manufacturing world.

NOTES.

Electric Lighting.—The large ball-room of the Wellington Club, Liverpool, has, up to the present season, been lighted by 550 wax candles on each ball night. Some weeks since the committee invited tenders for the lighting of the room by the electric light, and the offer of Messrs. Holmes and Vaudrey, on behalf of the Liverpool Electric Supply Company, Limited, was ultimately accepted. The light was tried for the first time at the ball on Thursday night, the 31st ult., and was much admired. The Swan lamps (over 100 in number) have been arranged inside elaborate cut glass chandeliers, producing a very striking and beautiful effect. The lamps are driven from a dynamo several hundred yards distant; and as a matter of precaution against variation or temporary break-down of the light, Faure-Sellon-Volckmar accumulators form part of the installation.

In America, Boston and its suburbs show a great in-

* See Electrical Review for 29th Dec., 1883.

crease in the use of the electric light. The number employed at the present time is 381. Mayor Martin, of that city, in a late address, stated that an electric light costs $236.25 per annum, a gas light $34, and each electric light displaces on an average 3½ ordinary street lamps. The mayor approves of the use of electric lights on public squares, but questions, on account of the cost, their general use for street lighting.

The Theatre Royal, Montreal, is to be illuminated by means of the electric light.

Mr. Robert Hammond's new work on "The Electric Light in our Homes" has been published this week, and the first edition is now out of print. The second edition will, it is announced, be published next week.

A numerous company assembled on Tuesday and Thursday evenings at Mr. Peter Brotherhood's premises in Belvedere Road, Lambeth, to witness an exhibition of electric lighting. The spacious shop was lighted on either side by Edison & Swan incandescent lamps, to the number of about 300, which had been specially fitted up for the occasion by the Edison & Swan Company. A single Edison-Hopkinson dynamo was employed, driven direct by one of Brotherhood's newly designed and much improved engines. Various forms of fittings suitable for ship work were shown, which included the newest patterns specially designed by the Company to give the best effect to the light and to guard against dirt, damp, and breakage. Outside, on the roof, were shown ships' dioptric lanterns, provided by Messrs. Chance Brothers, and fitted with 100 C. P. lamps, which, whilst free from the disadvantageous glare accompanying an arc light, yield a light four times as great and far more distinctive and penetrating than can be obtained from the best oil lamp. High up from the beams were suspended four inverted reflectors with a group of eight, 50 C. P. lamps in each, a pattern of lantern which has been adopted by the Admiralty for deck lights, and which, slung from the yard arm, suffices to illuminate half the deck. Later on in the evening, the incandescent lamps having been extinguished, the whole of the current from the same dynamo was directed, without further alteration, to a large search light with projector which was placed on the roof of the building, overlooking the river, whence its rays were directed on to the Houses of Parliament and surrounding objects with remarkable effect, and revealing all the details of the stonework with a distinctness never even seen in the brightest sunlight. As distinguished from his original engine, the novel features presented by Mr. Brotherhood's improved type consist in the adoption of piston valves and special arrangements for the effective distribution of the steam, allowing of bearings being fitted to each side of the crank, an economy of steam being obtained fully equal to that of any ordinary type of high speed engine, combined with durability and equable motion. The cylinders are 8 ins. diameter by 6 ins. stroke, and at 615 revolutions and 75 lbs. pressure, with a cut off of about $\frac{3}{10}$, 43 H.P. is obtained. The dynamo was connected direct by means of Mr. Brotherhood's new patent flexible coupling, which is likely to prove a most valuable means of getting over difficulties so often encountered through false alignment and back lash. It consists of a washer of leather, the outer periphery of which is held to one half of the coupling by a ring, the inner edge being similarly connected to the other half coupling; a radial distance between the two halves allowing of a considerable amount of flexibility. The dynamo, as before mentioned, is an Edison-Hopkinson with elliptical magnets, wound for 107 volts, and capable of maintaining 400 20-C.P. lamps, and notwithstanding the strain to which it was subjected when applied to the search light, no undue overheating was observable.

On Tuesday, the Streets Committee of the Commissioners of Sewers presented a report submitting for adoption a proposal of the Edison and Swan United Electric Light Company to continue the lighting of Holborn Viaduct for three months, from the 24th ultimo, on the same terms as under the previous arrangement (at the cost of gas). Agreed.

In a case which was heard on Friday week before Mr. Justice Lopes, the Marquis of Salisbury, as the proprietor, and Mr. F. Weiss, as the lessee of the house, 2, Durham Street, Strand, sought to obtain an injunction against the defendants, proprietors of the Adelphi or Tivoli Restaurant, to compel them to remove an obstruction to light and air, and abate a nuisance arising from works connected with electric lighting at the defendants' premises. Mr. Petheram, Q.C., who appeared for the plaintiff, said the works in question consisted of an engine and boiler, with a tall shaft or flue; and that, besides the obstruction to light and air, the operations were attended with great vibration, noise, heat, and offensive smells, all of which interfered seriously with the comfort and business of the occupants of the house, at the same time deteriorating the premises in value. The defendants in their pleadings denied that there was obstruction to light and air, or any nuisance; but, after the examination and cross-examination of witnesses for the plaintiffs, Mr. Reid, Q.C., who appeared for the defendants, admitted that the defence could not be sustained. Mr. Justice Lopes said there could be no doubt that the case for the plaintiffs was a very strong one, and that the erection of such a shaft was a very great interference with their rights. His lordship gave judgment for the plaintiffs, with costs against the defendants, who, it was stated, were to be indemnified under agreement by the J. B. Rogers Electric Light Company, which supplied the works in dispute.

Telephonic.—During the past year the Western Electric Company has established a warehouse in London for the supply of their magneto call bells, switchboards, and other apparatus connected with the telephonic industry. The company's new factory at Chicago is said to be the largest factory in the world devoted entirely to the manufacture of electrical apparatus, and with upwards of 700 hands on their pay roll, principally employed in the manufacture of telephone apparatus. Some idea may be formed of the importance which this industry has assumed in America, where the telephone being most largely used, and every improvement most readily adopted, we might expect the manufactures to be the most efficient and economical. The "Post," "Williams," "Western Electric," and "New Gilliland" magneto bells, the "Standard" switchboard—of which a larger number are in use than of any other kind—and other apparatus of the company's well known make are all kept in stock at their London warehouse, 59, Moorgate street, ready for immediate delivery.

On Monday morning telephonic communication was established between the National Telephone Company's Central Office in Aberdeen, and the Culter Paper Mills, at Culter, a distance of rather over eight miles. The distance just completed is the longest that has yet been established in Aberdeen, the line next in length being that connected with Stoneywood works, which measures 5 miles and 654 yards. There are now 278 subscribers connected with the Central Office in Market-street, and as the advantages of the system are being realised, there is no doubt the number will be increased to an indefinite extent. Mr. Miller, the energetic manager is enthusiastic in the work, and under his supervision the new lines are erected with marvellous rapidity. The wire now being used is much thinner and lighter, and at the same time greatly tougher and more durable than that which was first employed.

Messrs. Waterhouse, Winterbotham, and Harrison, writing to the *Standard*, say that the result of the litigation in the United States, respecting the Bell Telephone, will not in the slightest degree affect the validity of the Bell Patent in this country. The question of prior publication of the invention in this country was raised in the actions which have been tried both in England and Scotland, and the decisions of Mr. Justice Fry and Lord Maclaren upholding the

patent have since been confirmed by the unanimous decision of the Court of Appeal.

American news is to the effect that it is probable that the same issue which is involved in the suit now pending between the Bell and Drawbaugh Companies, that is, the priority of invention of Bell or Drawbaugh, may be passed upon in the suit of the Bell Company *v.* the Overland Company, which was to be heard at Philadelphia on January 21. In this cause the Overland Company has set up three defences. First—The prior invention of Drawbaugh. Second—The prior invention of Reis. Third—The claims of Baxter, whose patents are owned by the Overland Company. The Bell Company has met the Reis and Baxter defences, but has not yet answered the Drawbaugh defence.

The following relates to the litigation mentioned above: —"Philadelphia, January 25.—The application of the Bell Telephone Company for an injunction restraining the Overland Telephone Company from doing business, was denied this morning in the United States Circuit Court, Judges Butler, Nixon, and McKennan on the bench. The suit is one of great importance, as it involves the validity of the Bell telephone patent. If this decision is sustained, the right to manufacture and use telephones will be open to the public. The decision is based chiefly upon testimony similar to that given by more than a hundred witnesses during the last two years in favour of the claims of Daniel Drawbaugh to the invention of the first speaking telephone in 1870, six years before Bell applied for a patent. Judge McKennan subsequently refused the application of the same plaintiffs to prohibit the Overland Company from manufacturing and using telephone instruments."—[The Baxter telephone was described in the ELECTRICAL REVIEW for December 29th, 1883, p. 516.]

At a meeting of the managing committee of the Whittingham County Asylum near Preston, last month, it was resolved to accept the tender of Mr. G. Sharples, for the connecting of the Asylum by wire with his Telephonic Exchange at Preston, distant about seven miles. The connection had been made for a month upon trial, and was found to be a very great convenience. The Asylum is situated three miles from the nearest telegraph office, and two and a-half from the nearest railway station. The County Offices of Lancashire being situated at Preston, and connected with the Exchange, intercommunication between the two establishments is frequently necessary. The instruments used, are the Gower-Bell. In the erection of the line, it was found necessary, after leaving the township of Fulwood, to pass through the estate of W. F. Anderton, Esq., J.P., who is lord of the manor of Haughton. This gentlemen, not only allowed the wire to be taken through the centre of his estate, which is one of the most picturesque in this part of Lancashire, but advised his tenants to give any assistance they could. He also had Haughton Hall connected with the Exchange, the hall being situated about four miles from Preston.

Société Internationale des Electricians.—The first ordinary monthly meeting of this Society was announced for Wednesday evening, February 6th. During the evening the following matters were to be brought forward :—Analysis of the work of M. Clausius on a new theory of electric machines. Explanation of a note by M. Menges on the coupling of dynamo machines. Résumé of the work of Clark Maxwell on the fundamental principles of electricity. Electrical measuring apparatus (M. Carpentier). The secondary generators of Messrs. Gaulard and Gibbs. A study of potential energy (M. D. Napoli). Accumulators and transformers of electrical energy (M. E. Hospitalier).

The Society of Telegraph Engineers and Electricians.—The next meeting of the society will be held at 25, Great George Street, at 8.0 p.m., on Thursday, February 14th, when the following paper will be read by Messrs. R. E. Crompton and Gisbert Kapp :—"On some new Instruments for indicating Current and Electromotive Force."

The New Atlantic Cable.—The steamer, *Faraday*, with Mr. Bennett's new Atlantic cable on board, which put into Cork Harbour on Friday, last week, with a piece of chain entangled in her propeller, was on Saturday moved into smoother water, and the diver was able to clear the obstruction. The *Faraday* had on board 1,100 miles of cable, forming the first instalment of about 6,000 miles being manufactured by Messrs. Siemens Brothers & Co., Limited, for the "Mackay-Bennett" cables, and which will, when completed, form the fifth and sixth Atlantic cables made and laid by that company. The *Faraday* left Queenstown again on Saturday.

The Lundy Cable Company.—In our issue of January 26th, we published an extract from a letter written to the *Western Mail* by Messrs. Jones, Heard & Co., of Newport. This firm complained that in the Lundy Island Cable scheme no provision was made for the important town of Newport. The following reply appeared in the next issue of the journal above mentioned :—"I notice a violent letter in this morning's *Western Mail* from Messrs. G. W. Jones, Heard & Co., of Newport, to which, in justice to the company and in fairness to myself, I must reply. Had Mr. G. W. Jones (the late senior partner) been alive I should have consulted him, as I knew him well, and no doubt he would have given me valuable assistance ; but not knowing either of the present members of the firm, I did not consult them, and for this dreadful error on my part they publicly state that I have insulted Newport's business community generally. This is untrue mply, and is a wild statement made without any reference to facts. I did consult Newport, and have very many promises of support from Newport shipowners, merchants, and others. Although I tried my best to secure a Newport name on the board I failed to do so ; other promises of support I did get freely. I have, therefore, been 'careful to consult Newport on the matter.' My error has been that I have hitherto been unaware that Messrs. G. W. Jones, Heard & Co. constituted Newport. I sincerely regret and apologise for this, and I trust that Newport generally will forgive me. It will be well represented on the share list notwithstanding the letter referred to. The directors cannot neglect the interests of Newport in a scheme which must benefit the Channel ports generally and not particularly.

"Swansea, *January 18th.* HERBERT J. GOSS."

Brush Electric Light and Power Company of Australasia, Limited.—A general meeting of this company will be held at the office of Mr. Miall Fraser, 4, Copthall Buildings, on the 4th March, at twelve o'clock, noon, for the purpose of having an account submitted by the liquidators, as to the manner in which the winding up of the company has been conducted and the property of the company disposed of.

The British Spiral Telephone Wire Syndicate, Limited.—"This Syndicate has been formed for the purpose of acquiring the patents and rights of Mr. Gorham Gray, for and in his inventions of spiral telephone and telegraph wire, and the machinery and appliances for spiralling the same. By these inventions a result hitherto not only unattained, but deemed impossible, is claimed, viz.: *unlimited distance for both telephone and telegraph service underground, aerial, and submarine.* "The inventor has for a considerable time given the most careful attention to the overcoming of induction and retarding influences as affecting the electric current through a wire conductor, and it seemed to the inventor that instead of trying to hold in safe deposit this unseen force, the same force applied in an opposite direction, or around the direct current, so as to attract and throw off the disturbing outside influences, would leave the central *direct current* a clear

and undisturbed pathway for *instantaneous reproduction of sound*, or broken currents at the opposite end of a wire. The inventor was, however, impressed by the fact that the many attempts to produce a better conducting wire, *i.e.*, a better and more sensitive reproducer, had failed to make in the telephone a prompt and instantaneous reproduction, especially over long distances and in bad weather; and the same difficulties of retarding inductive influences were causes of delay in promptly replacing the current of electricity when broken by the sounders of the telegraph machines (*sic*). In order to produce a spiral outside current in a wire, and yet to leave a *core* for a direct undisturbed current, and more especially to increase the activity of the direct core current to its utmost capacity, and further to leave the longer route of the spiral service current to its own natural speed, the inventor decided that the core must be made *dense* and *hard*, so that every molecule composing that core should be affected from end to end of the wire in active agitation, while the spiral surfaces should be soft and absorbing for comparative slow conveyances of all retarding and outside inductive influences. The inventor has produced simple, little, and comparatively inexpensive machines, which are now *spirally grooving without cutting*, but by *impression only*, the best steel galvanised wire, at the great wire works of the Washburn and Moen Manufacturing Company, at Worcester, Massachusetts, United States. The wheel of a heavily-laden cart in its passage through mud throws a soft surface at the sides, which is a ready absorbent of rain, and hardens a track which is not an absorbent, but a pathway for running water. The inventor's machine, in grooving the wire, throws up soft spiral or cross section-conveying substances for inductive and retarding influences, thereby protecting and insulating perfectly the direct central core, which is a sensitive, active, and prompt reproducer. Long and careful tests were made for six weeks at the Patent Office (America) which established beyond the possibility of doubt the soundness and efficacy of the invention, and completely won over the highest authority on electric subjects, who granted the inventor a patent covering his invention fully as 'an improved electrical conductor for any and all uses.' Some five hundred miles of spiral wire have been strung in the states of Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania and Louisana. Satisfactory experiments have demonstrated that the *spiral wire* is the only unlimited *distance telephone, talking and telegraphing wire*, and for submarine use will supply the soundest telegraphic instead of the present weak shadowy current across the Atlantic. In short, *long* and *unlimited distance talking* and telegraphing is insured over a wire which costs only from one-half to one-fifth of the cost of the ordinary wires now in use. For telegraph use the spiral wire must, therefore be acknowledged as the only perfect conductor, breaking the circuit instantaneously, and admitting greatly increased rapidity of telegraphic communication. Its agitation is instantaneous throughout. The longer the wire, the less it is affected by any outside inductive influences, and an absolute uninterrupted pathway is insured through the core. The Syndicate will acquire both the patents (one in the year 1883, the other in 1884) for the United Kingdom, *i.e.*, one for the spiral wire itself, and the other for the machine for spiralling the same, and also the patent rights for Europe and the colonies, with the exception of Canada. It is deemed quite unnecessary to submit any estimate of the profits which must accrue to the Syndicate, as the importance of the inventions, and the vast field over which they extend must be apparent to even those who are unacquainted with commercial enterprise. It is intended immediately after the allotment of shares by the Syndicate to supply the spiral wire throughout the United Kingdom, and to organise companies for the purchase of the various European and Colonial patents, so that in addition to the large profits to be derived from the sale of the wire in the United Kingdon, the European and Colonial patents will (it is confidently believed) yield a bonus of from 200 to 300 per cent., to be divided *pro rata* among the members of the Syndicate." [The simile of the heavily-laden cart and the inventor's "spiralling machine" is too utterly delicious, and generally the language employed in describing the *peculiarities* of this wire is too highly technical. We need scarcely say that the inventor seems incapable of distinguishing the difference between the phenomenon which causes retardation in a submarine cable and those causes which interfere with overhead working. Electricians—at any rate, in this effete old country—will know how to treat this latest and most ridiculous of electrical *inventions*.]

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Indian and Oriental Electrical Storage and Works Company, Limited.—The second return of this company, made up to the 30th ult., was filed on 31st ult. The nominal capital is £40,000, in £5 shares; 35,000 shares have been taken, and upon 30,000 of these, £2 5s. per share has been called up, the remaining 5,000 shares being fully paid. The calls paid amount to £84,722 10s., leaving £7,777 10s. unpaid, but of this latter amount the sum of £7,272 10s. is due on account of a call of 5s. per share due on the 31st ult. Registered office, 19, Great Winchester Street, E.C.

Electrical Trading Company, Limited.—The second return of this company, made up to the 31st December, was filed on the 2nd inst. The nominal capital is £10,000, divided into 256 ordinary and 500 deferred shares of £10 each; 256 ordinary and the whole of the deferred shares have been subscribed for, and the full amount has been paid up. The calls paid on the ordinary shares amount to £2,360 13s. 6d., and upon the deferred shares to £5,000, leaving £199 6s. 6d. unpaid upon the former. Registered office, 23, Farringdon Street.

THE METROPOLITAN BRUSH ELECTRIC LIGHT AND POWER COMPANY, LIMITED.

IN our last issue we published two circulars respecting the above company; one issued by the "Committee of Investigation," and the other by the Secretary of the company. We have now before us three other circulars, and the report of the aforesaid committee. The former, all addressed to the shareholders, are, one from Mr. Alexander Peebles, one from Mr. J. Hamlyn Borrer, now chairman (in place of Sir M. Kennedy, resigned), and one from the committee of investigation. From this latter we will make two or three extracts, and then pass on to the more important document, namely, the report of the investigators. The circular contains, amongst other things, the following :—

> And, after numerous interviews and conferences between the committee and the board, and between Mr. Morris (of Messrs. Ashurst, Morris, Crisp & Co.), and Messrs. Linklater & Co., it has been agreed on all sides that, under the circumstances, the best course to be pursued is to pass the resolutions which will be found in the notice of the board of this date, convening an extraordinary general meeting of the company for the 12th February, 1884.
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> It will be seen that it is proposed by these resolutions to provide for the liquidation of the company by three members of the committee, acting in conjunction with Mr. Borrer and Mr. Tottenham, so that, instead of having professional liquidators acting independently of the advice of the shareholders, the conduct of the liquidation will practically be in the hands of a board of shareholders, who will act under the directions given to them by general meetings.
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> A claim will, it is now agreed by the board and the committee, undoubtedly have to be made upon, at any rate, the promoters for a very large amount, and the committee feel that, in order to enable them to negotiate with the promoters for a settlement of the claim, should opportunity arise, it is essential that there should be vested in the liquidators a power to compromise. A resolution (No. 4) is therefore inserted to meet this contingency.

The committee of investigation, in their report, say that "they determined to conduct this inquiry under

the heads set out . . . . in their natural sequence, as follows :—

"1. Promotion and formation of the company.
"2. Affairs and prospects of the company.
"3. The accounts of the company."

The committee, however,

"Having learnt from the secretary, that upon the 17th December, 1883, immediately after the general meeting, the directors had instructed Messrs. Walter Webb & Co., their solicitors, to take the necessary steps to carry out the proposed agreement with the Hammond Company, and to complete the arrangements with the Board of Trade respecting the proposed installation in the Holborn District, your committee considered it necessary first to deal with the 'affairs and prospects of the company,' in order to ascertain the grounds upon which the directors recommend the adoption of the Hammond Agreement, and the proceeding with the lighting of the Holborn District, so as to prevent your company being committed to an expenditure which your committee might, upon mature inquiry, consider inexpedient."

With regard to the agreement with the Hammond Company, the committee were, for reasons given, unanimously of opinion that it would be a most improvident one for the Metropolitan Brush Company to enter into, and a resolution to that effect was communicated to the secretary of the company upon the 10th ultimo.

The committee next proceeded to consider the prospects of the company in "taking in hand" the works in the Holborn district. After expressing very adverse criticisms on the estimates of Mr. Radcliffe Ward the engineer to the company, and after having submitted these estimates to the consideration of certain experts, the committee are not able to discover "the good and sufficient reason for taking in hand the Holborn district."

In connection with the subject of Mr. Easton's joining the board, it is stated that he did not become a shareholder until August 11th, 1883, and that his total interest in the company "is only 1,883 shares, 1,000 of which were bought as low as 6d. per share.

Coming next to the promotion and formation of the company, the case for counsel was prepared by Mr. Harold Brown (of Messrs. Linklater & Co.), and was laid before the Solicitor-General and Mr. Romer, Q.C. ; and

"The committee are of opinion that the promoters are, upon the facts at present known, liable to be called upon to repay to the company a very large portion, if not the whole, of the £235,000 paid for the licenses, and they further believe that when this liability is established, some, at any rate, of the promoters, are in a position to repay to the company whatever amount may be recovered."

In conclusion, the following paragraphs appear in the report:—

"The committee have already mentioned in their preliminary circular, that there is no reason why the shareholders should apprehend any further liability upon their shares, *except in the event of the policy of the directors being re-indorsed and further expenditure sanctioned*, and also that there is no reason why shareholders should part with their shares, at the absurdly small prices which the committee find have been paid for some of the recent transfers—such as 1s., and even 6d., per share.

"The assets at the present time, even if they were turned into money regardless of sacrifice, would probably amount to upwards of £26,000, and, *after making ample allowance for all expenses, including those of litigation with the promoters*, there ought to be, in the opinion of the committee sufficient to make immediate return to the shareholders of at least 4s. per share, whilst if the proceedings against the promoters are successful, which the committee anticipate with confidence, there will, of course, be a much larger return.

"On the other hand, if the policy of the directors be re-indorsed and the agreements contemplated by their report carried into effect, it is clear, from the terms of the proposed agreement with the Hammond Company, that a call of at least £100,000 must be paid within a comparatively short period.

"They, therefore, after the most anxious deliberation, came to the conclusion that it was necessary that they should file a petition themselves for winding up the company, and thus secure the right, if necessary, to go to the court and ask for the appointment of a nominee who should properly represent the interests of the shareholders.

"The committee acordingly instructed Messrs. Linklater & Co. to file the petition ; but, having done it in the interest of the shareholders, they place the petition in *their hands*, to be dealt with in every respect as the majority of the independent shareholders shall direct ; and part of the business to be transacted at the meeting will be to pass a resolution on the subject.

"The committee felt that there was no time to be lost ; and that they were correct is shown by the fact mentioned in paragraph 25. Had it not been for their action in filing the petition, the company would by this time probably have been pledged to the expenditure of at least £15,000 upon the Holborn order.

"Should the meeting pass resolutions for winding-up and appoint a perfectly independent liquidator, there will be then no difficulty in either dismissing the petition or taking by consent an order for continuance of the voluntary winding-up, under supervision. This will, at the same time, ensure that the liquidation will be conducted at the smallest possible expense, whilst all the powers of the court will be at the command of the liquidator, to secure the fullest investigation which may be required."

CITY NOTES, REPORTS, MEETINGS, &c.

Submarine Telegraph Company, Limited.

THE half-yearly meeting of this company was held at the offices, 2, Throgmorton Avenue, on Thursday afternoon, Sir Julian Goldsmid, Bart., presiding.

The secretary (Mr. S. M. Clare), having read the notice convening the meeting, the report was read as follows :—

"The accounts for the six months ending 31st December, 1883, show a balance of profit of £35,799 7s. 5d. in favour of this company, which enables the directors, after adding the sum of £8,111 2s. 6d., being 15 per cent. of the gross receipts, to the reserve fund, to recommend a dividend at the rate of 15½ per cent. per annum, and to carry over a balance of £176 1s. 9d.

"In comparing these accounts with those for the corresponding period of 1882, it will be found that, although the gross receipts have fallen £5,166 13s. 9d., the net receipts are only reduced by £2,465 19s. 1d., in consequence of the reduction of the working expenses.

"The falling-of in the receipts is partly due to a diminution in the number of messages transmitted, and partly to the shorter length of the messages ; and the reduction in the expenses arises chiefly from the item of repairs to cables, which have cost in the six months £2,516 9s. 8d., against £4,417 9s. 6d. in the six months ending 31st December, 1882.

"During the half-year there has been but one breakage in the cables between England and France, which was very speedily repaired ; on the other hand, the two cables to Holland, belonging to the Government, have unfortunately been interrupted since November, and the engineer has not yet been able to repair them. This is partly owing to the weather and the fishing operations in the North Sea, which interfere with this work, but chiefly to the very weak condition of the cables.

"Arrangements have been made with two French newspapers, the *Paris Morning News* and *Galignani's Messenger*, for letting to each of them the use of a wire between London and Paris during the night on the usual newspaper terms.

"The directors regret to report the death of Mr. George Copeland Capper, the first auditor of the company. As by the deed of settlement only two auditors are required, they recommend that the vacancy be not filled up."

The Chairman, in moving the adoption of the report and accounts, said he mentioned at the last half-yearly meeting, that there appeared to be a stoppage of increase, if not a slight decline in the number of messages dispatched between England and the Continent, and this was confirmed by the experience of another six months. The number of messages for the six months to the 31st December, 1882, was 1,422,178, and for the half-year ending 31st December, 1883, 1,396,634, a falling off of 25,544. In addition to that the process of condensation, or reduction in the number of words of each message, was still going on ; the number of words for the half-year ending 31st December, 1882, was 18,619,019, whereas in the period now under review the number of words was only 17,226,788, showing a decrease of 1,392,231. Putting this in the form of average, whereas in the period up to the 31st December, 1882, the average number of words per message was 13·09, in the period under review it had decreased to 12·33 words per message. As a consequence of this, there was a large falling off of receipts. The question was, how long was this to go on ? There must be a minimum at which the compressive power of telegraphy would end. He had no doubt that they would have to face a further reduction, but he was inclined to think that somewhere between 10 and 12—he hoped about 12—words per message the reduction must cease. They would see that this was a matter entirely beyond the control of the directors. Passing to another matter mentioned in the report, he remarked that their cables were all in very good working condition ; but they had had very great trouble for a long time with the two Government cables to Holland. The Government was alive to the condition of those cables, and the matter was now receiving serious consideration ; meanwhile the cost of repairs was very heavy, communication having been interrupted for two or three months, while at the present time, notwithstanding all the efforts of their capable engineer, the cables had not yet been put in order. The exact position of the association in all other respects was very much as at the last meeting. Having alluded with an expression of regret, to the death of Mr. Capper, the first auditor of the company, the chairman concluded by moving the adoption of the report.

The Hon. Ashley Ponsonby seconded.

The Chairman, replying to questions, said he did not know the exact age of the Dutch cables, as they were not the property of this company, but belonged to the English Government ; they

were very old, and in miserable condition. With regard to their concession, if he had anything to say, he thought it would be very unwise, in the interests of the shareholders, to say it. As to the securities, which one gentleman had suggested should be given up, in order that they might invest in more profitable ones, even if they could realise those alluded to at a profit, they would have to pay very much dearer for others to replace them; consequently he saw no advantage in making any alteration.

The resolution was put and carried unanimously.

The Chairman then moved, in accordance with the recommendation of the directors, that a dividend for the half-year to the 31st December, 1883, of 15½ per cent. be declared, and become payable on the 1st March next.

This was seconded and unanimously agreed to, the usual vote of thanks terminating the proceedings.

Anglo-American Brush Electric Light Corporation, Limited.

THE third ordinary general meeting of this corporation was held at the Cannon Street Hotel on Wednesday afternoon, for the purpose of receiving the report of the directors, and the accounts for the year 1883, a *resumé* of which was given in our last issue. Lord Thurlow presided.

The Secretary (M. Emile Garcke) having read the notice convening the meeting,

The Chairman said the report and accounts had been laid before the shareholders in an unusually extensive and exhaustive manner, as it was the wish of the board to conceal nothing whatever from them, but to place before them in a true and impartial light as clear and complete a statement as it was in their power to do. An almost complete change of management had taken place since last spring. Sir Henry Tyler, their former chairman, who, he was bound to submit, rendered most important and conspicuous service to the corporation in its earliest stages, but who, unfortunately, by the policy he pursued in distributing the solid fruits of his success, lost the confidence of the great body of the shareholders, had necessarily retired from office, and several of the directors who had identified themselves with his policy had naturally followed. To fill the vacancies thus caused, Mr. Gibbs and Mr. Woods had been appointed, and he could say, without hesitation or fear of contradiction, that their selection was singularly happy. Mr. Gibbs brought to the board not only eminent business qualifications and a very great commercial connection, but real administrative power, and took, moreover, an interest which was as practical as it was earnest and deep in the science of electric lighting. Mr. Woods, as Vice-President of the Institution of Civil Engineers, perhaps better than anyone else in that room, could pierce the future of electric lighting, and appreciate the part which that corporation was likely to play in its development, and he thought his presence that day afforded the best index to what were his convictions on that important point. As regarded himself, he could assure them that it was only after he felt satisfied that it was hopeless to think of persuading Mr. Sellon—the one man pre-eminently fitted for the post—to undertake the duties of chairman, and after satisfying himself of the present position of the corporation, and of the hopeful and honourable foundation on which it rested, that he finally made up his mind to endeavour to serve them to the best of his ability. The board, thus reconstituted, entered at once upon its labours, with the fixed determination of probing the accounts of the corporation to the bottom, and of introducing economies and reforms in all departments wherever consistent with efficiency. They were fortunate in securing the services of Mr. Frank Wynne as general manager and engineer, and M. Emile Garcke as secretary, to carry out their instructions. Those gentlemen had thrown themselves heart and soul into the business of the corporation, and had laid the directors and the shareholders under considerable obligation. Passing to the accounts, his Lordship said the mode of bookkeeping which had previously been employed was found to be in many respects unsatisfactory, and in all respects very cumbrous, and such was the difficulty experienced that it was thought desirable to call in the services of an eminent firm of chartered accountants, Messrs. Cooper Bros. & Co., who had gone most carefully into the accounts, and to them they were indebted for the valuable report and the much more simple method of bookkeeping which had been introduced. The basis of the balance-sheet was necessarily to be found in the figures of the balance-sheet for the preceding year, and those figures had to be discounted not only by the actual business transactions during the last twelve months, but by the adjustment of various heavy outstanding and indefinite claims, for which no adequate provision had been made. It had been the aim of the board to make this balance-sheet as clear and comprehensive a document as possible. They had concealed done of their difficulties, and, notwithstanding that there was a heavy adverse balance, there was nothing, in their opinion, in the present position to cause uneasiness, or to interfere with the prospect of a good dividend in the future, and possibly an interim dividend in June, if only the recommendation they would make were carried out in its entirety. He thought it was desirable that they should disabuse their minds of the idea that large sums set out on both sides of the account represented hard cash completely lost; he held that they represented assets in many cases of great, although undoubtedly fluctuating, value—assets which remained their property, although in the meantime difficult of appreciation or realisation. The corporation had been engaged in expensive litigation; but he could, without hesitation, congratulate them upon the results. They had adjusted matters with Mr. Lane-Fox; had arranged their difficulties with the Hammond Company; and had received judgment in their favour in one of the cases pending at the time the report was issued, the other having been satisfactorily settled out of court; while, as a result of certain negociations skilfully and energetically conducted by Mr. Sellon, a satisfactory arrangement had been arrived at with the British Electric Light Company in regard to the litigation respecting the Gramme patents. That Company admitted that the Brush machine was no infringement of their patent and that they had no claim in respect of it on the corporation; and the corporation, on their part, agreed to pay a royalty to the owners of the Gramme patent upon all machines in which that patent was used. The directors, therefore, came before the meeting absolutely free from all litigation. They had also arrived at satisfactory working agreements with their subsidiary companies; and here he desired to say that for such agreements to work well it was necessary that they should be satisfactory to the subsidiary companies as well as to themselves; no one-sided agreement would have been of avail. The board realised that the subsidiary companies had their difficulties to contend against as much as they had, and that they were entitled to every assistance it was in their power to give them. With regard to one of those companies—the Metropolitan—they deeply deplored the difficulties that had arisen between the board and the shareholders, but for his (the chairman's) own part, he was not quite without hope that they might yet be arranged; they had done all in their power to render assistance to the Metropolitan Company, and should continue to do so. As regarded the Scottish and Dublin Companies, which had gone into liquidation, he maintained that the policy of this board was quite sound. The great body of both those companies desired to go into liquidation, and this company rendered it easy for them to do so by waiving their shares and in exchange taking back their licenses and the power to enter their territories. The Scottish Company, whether from over caution or from supineness he could not say, did little or nothing; but since the liquidation of that company, the directors of this, the parent company, had entered upon an active canvas, and had already seen enough to justify them in the conviction that they had a very large field for doing an important and lucrative business. The board had also been successful in obtaining several large cash payments that were contested, and he might say that at present they owed no man anything; they owed their creditors a sum under £8,000, while on the other hand their trade debtors owed them £17,000; then, as regarded the banking account, they had a balance in their favour of £4,000, whereas at the time he joined the board eight months ago they owed the bank £25,000, and the debt had previously been £40,000. They were in negociation with the view of completing heavy contracts, not only with leading commercial houses, but with foreign and colonial governments, and they had a largely increasing business of private installations. It was an old saying that nothing succeeds like success, and in their case the corner seemed to have been fairly turned. Their general charges had been reduced by one half during the last six months, while on the other hand the volume of their business had increased by over 70 per cent.; the only thing, therefore, that seemed necessary now, was to find the means of placing the shareholders in a position to profit by this welcome change. Their law advisers had informed them that that could only be legally done by reducing their capital. Of course, a proposal of that kind was one that was not to be lightly made; nor would it be unless it appeared, firstly, absolutely necessary to enable them to reap the benefits of the future, and secondly, that it was justified by reasonable prospects of such benefits accruing. They held that the report showed that those two conditions were fulfilled. Their shares, at half their present nominal value, would shortly rise in the market to a much larger figure than they now stood at, and they would also have the consciousness that they were entering upon a period of accruing dividends. Their proposal was to reduce the capital by one-half. The effect would be to enable them to participate in the profits they were now earning, and which, otherwise would have to be applied to reducing the large adverse balance. One point in this connection he wished to remark upon. Under Article 56 of the Articles of Association the directors were entitled, when paying a dividend of over 10 per cent., to a sum equal to one-tenth of all profits beyond that 10 per cent. It was proposed to bring forward at the next general meeting a resolution "that in Article 56, line 5, on page 21 of the printed Articles of Association the words one-twentieth be inserted in place of the words one-tenth." This point had escaped the notice of the board until after the report was issued, otherwise they would have come before them that day for permission to alter the article. In the meantime, however, the directors would act in regard to this matter as if the alteration had already been made. The board were unanimously of opinion that the application of the remedy they proposed, by reducing the capital, would at once place the corporation in a brilliant financial position, and they therefore desired to press its adoption as strongly as they could; at the same time they fully recognised that it was a matter which should not be pressed unduly against the judgments of the shareholders, and if, after giving mature and serious consideration, they did not agree with the board in the expediency of adopting that course, they would then, although with the greatest reluctance, be compelled to withdraw the resolution, at all events for the present. His lordship, whose remarks were frequently applauded, concluded by moving the adoption of the report and accounts.

Mr. J. S. Sellon, vice-chairman, seconded the resolution, and said the board desired to impress the shareholders with the necessity of showing, as partners in this property, a united front, and

a determination to live down and put to shame the machinations from which they had suffered so greatly hitherto. He did not believe the most sanguine of them could realise at present the immense applications which must emanate from this new industrial science, and he expressed his unvaried belief in the unassailable value of their patents, and that they possessed a very firm foundation for successful and economical electric lighting. He would repeat what he said last year as to the absolute proof they could give of the great efficiency of the Brush machine. They had at that time carried on the City lighting for two years over a circuit of three and a-half miles with a single wire of small diameter, at less than £100 per mile, and one machine which had not given a moment's trouble. They were still working under the same advantages, a state of things, he ventured to say, that was unparalleled, and as yet unattained with equal facility, certainty, and economy by any other system. Very great and important improvements had been made upon the original and excellent type of Brush machine, which removed it even further out of the range of competition.

Mr. Sutherland said, that although he contended that very great blunders had been committed in the financial administration of the affairs of the corporation, he thought they ought not to judge too hardly those who had had the management of an affair which had turned out unfortunately, as he believed for them all. In the somewhat gloomy aspect of affairs, there was a certain glimmering of hope; he alluded to the undoubted and exquisite quality of the Brush machine, of which he had had opportunities of obtaining personal testimony of the most extensive character. The progress of electric lighting was as absolutely certain as anything could possibly be; it might be delayed, it might be hampered, it might be opposed by the great interest of gas, and on account of its weakness, and the folly and quarrels among the promoters of the electric light itself; but it could not fail to be seen that the progress of electric lighting was becoming day by day, and night by night more general and more real. One thing he saw clearly, and that was that the various inventors who had been opposing each other hitherto, in order to carry out the work they were destined to achieve, must sooner or later come together and amalgamate, and they would not only require all the capital they had, but a great deal of fresh capital in order to carry out the work that was quite open before them. He could not but feel that this re-adjustment of their capital was a most painful and sad necessity, but at the same time a very wise and prudential measure.

A Shareholder inquired whether the sum put down as by manufacturing account, £7,700, was for the whole twelve months.

The Chairman said that sum, no doubt, represented the manufacturing profit as shown on the twelve months, but for a great part of the twelve months, notably the first six, and even to some extent for a longer period, they had been engaged in a great deal of work which was not of a remunerative character, such as exhibition work, and that item represented really the profits realised within the last few months.

Mr. Hammond alluded to the Articles of Association, by which the directors were empowered to divide among themselves one-tenth of the profits beyond 10 per cent., and said if the directors, under that article, divided amongst themselves eighteen months ago the sum of £230,000, ought they not now to refund that amount? It was admitted that it ought not to have been divided, and if there had been a mistake, surely those gentlemen ought to refund the money.

Mr. Nettlefold said he had hoped the distribution which took place eighteen months ago would not have occupied the time of this meeting. There was no report that the division was wrongly made. Of course, they all had their opinions as to the wisdom of that distribution, but it was very easy to be wise after the event. At the time the assets in the hands of the company were imagined to be very valuable; those assets were shares of the sub-companies, which afterwards proved of very little value. He had gone very carefully into figures, and if the directors were able to carry their resolution, they would soon see their shares at par; they would not only pay off the adverse balance, but would be able to pay a dividend of 5¼ per cent.

The Chairman said they must look at things as they were now; it could be of no avail to wrangle over what took place eighteen months ago. What was done then—he had it on high legal authority—by Sir Henry Tyler was perfectly legal, and he must remind shareholders that it received their approval at the time. Having expressed the opinion that the shares in the subsidiary companies might yet turn out of considerable value, his lordship, referring to the remarks of Mr. Sutherland, the chairman of the Peninsular and Oriental Company, observed that he was informed that that company were considering whether they should not have their whole fleet lighted by electricity.

The motion was then put to the meeting, and carried unanimously.

Mr. Sellon moved the re-election of Lord Thurlow, Colonel Steuart, and Mr. Woods, as directors, and paid high tribute to the worth of each of those gentlemen.

Mr. Brooksbank having seconded, their re-election was unanimously agreed to.

Mr. Ash moved the re-election of Messrs. Cooper Brothers & Co., as auditors, which was seconded by Mr. Braithwaite, and carried.

The Chairman then moved the following resolution:—"That the capital of the corporation, which now consists of £800,000, divided into 80,000 shares of £10 each, of which 13,701 shares have been issued, and are fully paid, and 26,999 shares have been issued and have £8 per share paid, or called up thereon, be reduced to £400,000, divided into 80,000 shares of £5 each, and that such reduction be effected by cancelling paid-up capital which has been lost or is unrepresented by available assets, to the extent of £5 per share, upon each of the 40,700 shares which had been issued, and by reducing the nominal amount of all the unissued shares from £10 to £5." His opinion was that if they pursued this course it would have the effect, not of halving, but of doubling the value of their property, for it would open up the road at present closed against the declaration of dividends. He could assure them that the incidence of the proposal to deal with the £8 shares in precisely the same manner as with the £10, or fully-paid shares, had been carefully considered, and the conclusion arrived at was that it was impossible to do otherwise, with justice to the whole body of the shareholders. They had carefully worked out figures, and they found that, if the sum of £35,300—which would represent 10 per cent. on the present paid capital—were available for dividend, the fully-paid shareholders would receive, in the event of the proposed reduction of the capital taking place, about 17s. 4d. instead of the £1 which they would at present receive, while the present partly paid up shareholders would receive 17s. 4d. instead of 16s. as now. If the course recommended were pursued it would be in the power of the £8 paid-up shareholders, by paying the remaining £2 in advance of call, to place themselves in a better financial position than that now occupied by the £10 shareholders. It was important that that resolution should be passed, and in its present shape. It rested with the shareholders to further strengthen the hands of the directors in the battle they had to conduct.

Mr. Sellon seconded the resolution, and said, the fullest consideration and utmost solicitude had been given to arrive at an equitable and agreeable solution of a very difficult problem.

Mr. Hall said, supposing the £8 shareholders should choose to remain as they were, he did not imagine there was any intention on the part of the directors to call up the remaining £2, and that they would receive dividend *pro rata* with the other shareholders.

The Chairman said that was the view taken by the board.

The resolution was carried unanimously, and a vote of thanks to the Chairman having been accorded, the meeting terminated.

Jablochkoff Electric Light and Power Company.

AN extraordinary general meeting of the shareholders of this company was held at the City Terminus Hotel, Cannon Street, on Friday, the 1st inst., Mr. James Wilson presiding.

Mr. F. R. Reeves read the notice convening the meeting, which was held to pass the following resolutions:—1. That this company be wound up voluntarily. 2. That William Augustine Spain, of 76, Coleman Street, London, chartered accountant, be and is hereby appointed liquidator of the company. 3. That a general authority be and is hereby conferred on the said liquidator to transfer the business and property of this company to a proposed new company when incorporated, and to be named the Jablochkoff and General Electric Company, Limited, or such other name as shall be decided upon, and to receive in compensation for such transfer, shares or other like interests in the said company, as contemplated by the 161st Section of the Companies' Act, 1862. And for that purpose to enter into an agreement with the said new company for the sale to that company of this company's business and property upon the terms of the draft agreement in that behalf to be submitted to the meeting.

The Chairman said:—Ladies and Gentlemen,—As stated in the circular sent to you, since our meeting last October we have done our best to hold this property for your benefit, and we have only been enabled to do so under the greatest difficulties. Petition after petition has been lodged against us by creditors whom we have not been able to pay, in consequence of shareholders not paying their calls. The foundation of the whole of our difficulties has been caused by this; shareholders withholding their money as soon as they saw we were embarassed, while we have been unable to recover payment, in many cases, of our just claims, and where we have received anything, we have been compelled to accept very reduced amounts in order to procure cash to carry on our business. Notwithstanding the petitions, we have held our own, and proved that all the statements made against us were entirely false, as to the formation of the company, and other matters. All the verdicts were given in our favour; but, unfortunately, those who have proceeded against us having no money, the costs fall upon us just as much as if the cases went against us. The company is intact, the works are proceeding as usual, and, of course, we have the patents we purchased. Finding we could not go on for ever paying money to those who seek to gain an undue advantage over us, we thought it better to call you together and get your approval of the reconstruction of the company altogether, upon terms that will be read to you by-and-bye. In a reconstruction of the company, we consider, with our reduced capital, and with our works in a more prosperous condition, that is, full of work—for at present people, knowing that we are in a difficult position, and not knowing whether we are likely to live or not, refrain from giving us contracts, while the expense is just as great as if there was a large amount of work being done—we feel perfectly certain that an amount of orders for lighting from private persons and public bodies will flow in very quickly. I therefore beg to move the first resolution, that this company be wound up voluntarily.

Mr. Marten seconded the resolution.

Mr. Percival Smith thought an opportunity should have been

given to shareholders to know what was offered in exchange for the present company. This was rather a speedy turn of affairs, and he should like to know more before it was decided to wind up.

The Chairman said the court had already appointed a provisional liquidator, upon the application of Mr. Hulett, whose petition would be heard on Saturday, the 2nd inst. That liquidator was the same gentleman as was named in the second resolution. They would have to wind up, and it was in their power now to decree that that should be done voluntarily, whereas if they did not do so, the court would probably order a compulsory winding-up, as there was absolutely no defence to Mr. Hulett's petition.

The Secretary then read the draft agreement, which provided for the purchase by the new company of the plant, fixtures, and business of the present company, for the sum of £55,000; £40,000 in fully-paid ordinary shares, £10,000 in first mortgage debentures, and £5,000 in cash, or the whole of the £15,000 in cash, at the option of the directors of the new company. The capital of the new company would be £120,000, in £1 shares—40,000 ordinary and 80,000 six per cent. preference shares; this interest not to be cumulative. The ordinary shareholders would have the remaining profits up to 6 per cent., and the surplus would be equally divided between the two classes of shareholders.

Mr. Smith desired to know if there was no power to oppose the petition of Mr. Hulett.

The Solicitor of the Company stated that Mr. Hulett had presented a petition which would be heard the next day; in the meantime he had applied, as he was entitled to do, for the appointment of a provisional liquidator, and Mr. Spain had been appointed. There could be no doubt, seeing the position of the company, that the Court would order it to be wound up. Mr. Hulett was the holder of an unpaid acceptance, and there being no funds, the case would go as a matter of course. The only thing to be done was to pass the resolution moved, and endeavour that it should be adopted, rather than that the winding-up should take place under supervision. The principal object of the voluntary course was that it left more control in the hands of the company, and saved a considerable amount of expense.

Colonel Britton expressed his opinion that the shareholders should have been informed of the nature of the agreement before being called upon so hurriedly to come to a decision.

The Secretary said it was impossible that copies of the agreement should have been in the hands of shareholders before that meeting, the necessity of calling which had been forced upon the directors very hurriedly, in consequence of two petitions. They had only just the legal number of days in which to call them together to decide what should be done. The directors resolved in October last, if the shareholders did not respond to the call, to advocate a reconstruction of the company, and certain gentlemen who had the means had signified their willingness to join the company, and assist in finding the funds, on the provision that a new company was formed. There had been absolutely no time, however, since the necessity for this meeting arose to circulate an extract from the agreement to give them an idea of its nature. The new company would purchase the whole property, excepting the book debts, of the existing company, for the sum of £40,000 in 40,000 ordinary shares, which would give rather more than one £1 share for every existing £5 share. A large number of shares had been forfeited in consequence of not being paid up, and suffi would be realised to satisty the whole of the claims against the present company. They had every reason to believe that the shares of the new company would be readily subscribed by the public, who would come in upon advantageous terms. The business was one capable of development; they had a large stock of plant and machinery, and they had obtained a very good name for the work they had done, both in arc and incandescent lighting. A number of contracts had been offered which the directors were unable to take up in consequence of the difficulties. No one could doubt that the electric light was advancing steadily in public favour, and it was, in fact, *the* light of the early future. Their system enabled them to manufacture so cheaply that they could compete on very favourable terms with other companies.

The Chairman, having again remarked that the terms set forth in the agreement were absolutely the best they were able to offer, put the resolution to the meeting, when it was carried without dissent.

The second resolution, moved by the Chairman and seconded by Mr. Haden, and the third, also moved by the Chairman, Capt. Evan Evans seconding, were then put and carried unanimously, whereupon the meeting terminated.

British Insulite Company, Limited.

THE second annual general meeting of the shareholders of this company was held at the City Terminus Hotel on Monday, the Right Hon. E. P. Bouverie presiding. The following report was submitted to the meeting:—

"The directors have now to submit to the shareholders a statement of the accounts of the company for the year ending December 31st, 1883.

"It is with regret that they have to call attention to the unfavourable balance of the profit and loss account. It must, however, be borne in mind, that in fact the company has been only turning out their goods made of insulite during the last six months of the year, while the expenses of the company have been running on for the whole year. This has, of necessity unduly weighted the year's expenditure, compared with the return obtained in the course of it.

"It was believed at the outset of the company's operations that their special material would be largely in demand, in its first state of manufacture, for the purposes of Electric Lighting and Electric Railway Companies, for the successful operations of which companies such a material, cheap and efficient, is obviously of great importance.

"From causes the board need not enter upon, it is well known that there has not been that rapid development of electric lighting and electric railways as there appeared at one time to be every reason to expect. The only electric railway made in the United Kingdom since the commencement of this company has been insulated with this material, and with complete success.

"Hence the board of the British Insulite Company were forced to look in another direction for the profitable employment of their patents, and they have endeavoured to find a market for their material, not in its primary condition, but made up into various electric appliances for general, domestic, and medical use, for which it is eminently qualified. The sale of these appliances has met with much success, but time is of course requisite to make them widely known and appreciated. A market for these products had to be created and developed, and it was not to be expected that it would at once become a very large one, but the following monthly statement of the gross amount of sales for the six months ending December 31st indicates a growth of demand which the board trusts will be deemed not unsatisfactory:—July, £620 14s. 10d.; August, £546 1s. 0d.; September, £704 4s. 6d.; October, £724 13s. 10d.; November, £1,171 6s. 3d.; December (holiday month), £677 15s. 7d. The *two first weeks* of January this year have yielded £657 14s. 5d.

"There can be no doubt that insulite possesses the peculiar and valuable qualities which have been claimed for the invention—that it can be made in its raw state very cheaply, and that it is eminently adapted not only for the purposes to which it is now being applied, but for electric insulation generally. On the other hand, the insulating materials hitherto in use are natural vegetable products, of which the supply is becoming less equal to an increasing demand, and which it may fairly be expected, therefore, will find a successful rival in insulite.

"The board, while giving every attention to the administration of the affairs of the company, have not thought it right, in present circumstances, to draw the fees allotted to them.

"Sir George Rickards and Mr. Edward Easton retire by rotation, under the Articles of Association, and offer themselves for re-election."

The Secretary (Mr. Greenhill), having read the notice convening the meeting,

The Chairman said it was his duty to move the adoption of the report and accounts, and in doing so he wished to make a few remarks. The fact was, as stated in the report itself, the result of the accounts must necessarily be disappointing to the directors as it was to the shareholders; but the truth was that, in point of fact, they had only been on their legs, and really at work for six months, and the business therefore was merely in its infancy, and not such as they believed it was likely to be. They had, as he explained at the last meeting, not only a great deal of trouble in getting appropriate premises to establish the works, but they also had to get machinery of a special character devised, and this took a considerable amount of time, so that they did not get fully to work, and put the goods they now offered, into the market until the beginning of June last year. Referring to what was stated in the report, he thought he ought to say that the original idea which prevailed in the minds of the board, and of those gentlemen who joined the company, was that they would be able to supply in a very large way the material which they made, in its comparatively raw state, to the public, particularly to those using electric lighting and electric railways. If they looked into the history of those things for which the material which was the subject of their patents was especially appropriate—electric lighting and railways—it would be seen that the public did not rush into them on such a large scale as was expected, and the result practically was that there had not been that extraordinary extension of the application of electricity to public purposes, and to lighting especially, as it was imagined there would have been. It was not necessary to occupy their time with a discussion of how that could be explained, but he imagined that a great deal of the explanation was to be found in the fact that the enterprise for electric lighting, which promised very highly at the outset, had been overlaid, as it were, by public interference, and that, instead of receiving encouragement of every kind, such precautions were taken, and such elaborate provisions made to prevent the realisation of excessive profits by means of electric lighting, that the companies themselves were really overburdened with the difficulties laid in their way, and there had, consequently, been no large development of electricity in that direction, so that the patent belonging to this company, which was of a subsidiary character, was not immediately valuable, because there was not a large demand for the article. It was satisfactory to know, at the same time, that the only electric railway working, he believed, in the world, that at Portrush, constructed by the late Sir William Siemens, depended on the application of insulite as an insulator, and that that application had been perfectly successful. This company supplied the material, which had given every satisfaction, and answered the expectation entertained of it; this was a proof that their anticipations with respect to the scientific value of the material was demonstrated. Behind this was a very important point, the commercial value. Not having the demand they expected, and, he thought, had reason to expect, for the purpose of electric lighting, their business had not been so large as they had antici-

pated. Gutta-percha and caoutchouc were the materials now principally used for electric lighting insulators, and he was told that the town of Birmingham alone, if the electric light were adopted on so large a scale as was at one time supposed, would exhaust the whole stock of gutta-percha in the kingdom. But leaving that aside, they had turned their attention, with the assistance of Dr. Fleming, the inventor, to the application of their material to other comparatively smaller appliances, batteries, bell-calls, and so forth; but the demand so far had not been on such a large scale as they might hereafter expect. The figures which appeared in the report indicacated the amount of gross business during six months; they had practically done none before. It was satisfactory to know that for the month just passed, the return was £1,046, which showed that the demand was growing, and that the public was perceiving the value of the material, which they might hope soon to do a large business with. Behind this there was the question whether they were working at a profit. In the first instance it was obvious, as stated in the report, that as regards the profits of the year, carrying on business for six months only would necessarily show but a beggarly return for the outlay during the twelve months. In a manufacturing business of that kind, carried on by a company, there was a considerable amount of establishment charges, which would be small ratably on each item on a large scale, but when the business was not great, the rate would be such as to render that unprofitable which would otherwise be profitable. That would, of course, be remedied by the extension of the business, which they felt justified in believing in from the figures given. But beyond all that, there was something else. Quite recently, their very skilled auditors, who had been looking narrowly at the figures, expressed themselves not satisfied that they were charging a sufficiently high price for what they turned out to make it highly remunerative, and that, even with a larger business, they would not make a great profit, if any at all. This was a very unsatisfactory statement, but he thought there was some error in the statement of accounts, only to be detected by an examination of all the books, accounts and stores. Therefore, the board had done what they thought right, and he hoped the shareholders would approve of their action, and had asked Mr. Price, who was himself largely interested in the company, to go into the matter thoroughly again, and investigate the stores and books at the works, and see whether his theory was a sound one or not. If he was right, they must raise the charge for their manufac- but the directors were under the belief—and he (the chairman) still clung to it—that the charges, as compared with the articles turned out, were very remunerative, and calculated, on a large scale of business, to return a considerable profit to the company. This being so, the board had consulted together, and they thought the proper thing to do was to adjourn the meeting till some time within six weeks, so as to have everything investigated. In the meantime, he hoped the shareholders would agree to the formal resolution adopting the report and accounts. Speaking generally, his own notion was—and he believed it was shared by his colleagues—that this business was yet in its infancy, the cost, therefore, being more than the returns; but it was capable of being very much improved. One evidence in their favour was, that gentlemen who had once taken their produce had come again for more, and this showed that those who had purchased what they had made were satisfied with the result. Of course, it would take a long time to develop a business. He believed that even a bad thing could be made profitable by extensive advertising; but they were obliged to husband their resources, and could not expend very large sums in advertising. Still, there was great promise, and if they once could get the consumption of their produce on a large scale assured, and for the cells, for instance, which they made, which could at once be substituted for the ordinary cells, which were now made of glass, and were not nearly so satisfactory as theirs, though a little less costly; if they could once get that, they might have a very large business indeed. He would now move that the report and accounts be adopted, with the undertaking which the directors were desirous of giving—that they would have the matter about the cost of the manufacture investigated in a most thorough and complete way, and in the course of the next six weeks call them together and give them a statement of the result. He ought to mention that Sir George Rickards was kept away by a severe domestic calamity, and desired him to apologise for his absence; he fully concurred in all the proceedings of the board, and, indeed, they had had no disagreement on any point whatever. They had tried to make it a profitable business, and they felt that it would be so, although it took some time to develop it, and possibly at the outset might involve some sacrifice on the part of the shareholders; but there was a prospect of their outlay being more than returned. Some correspondence had taken place with the parent company, with a view to obtaining very easy terms for the patent rights for the rest of the world. If that could be done, it would be an advantage to them, for they might see their way to an export business, which at present, being only the British Insulite Company, they were debarred from. The commercial value of the patents remained to be tested, but there was no doubt about the scientific value, because in Germany, where this was patented, careful and scientific tests were made, and no patent was given unless the public department was satisfied that the article was a sound one. It ought to be of considerable value, though they had so far lost money in working the British Insulite Company, and the parent Insulite Company ought to be willing to make some reasonable terms for the patent rights for the rest of the world. The chairman then concluded by moving the resolution.

Mr. J. Dummett, a director, seconded.

A Shareholder remarked on the difference in the return given in the report for sales during the six months, and that set out in the profit and loss account; the former sum being £1,400, and the latter £3,017 only, and said it appeared to him to be an extraordinary discrepancy.

The Chairman said he had been struck with the same thing, but on going into the figures he ascertained that the profits were stated with the sales at the gross figure.

Mr. Porter observed that when this company was first started he was under the impression that the material would be very valuable, not only for electric lighting, but for ordinary telegraph insulating purposes; if that were the case, there should be an enormous demand, and they should have no difficulty in selling the material. But there was another thing more important than that he wished to remark upon. Supposing the demand increased, the question was, would it pay at the present prices? Looking at the accounts before the meeting, he did not think it would do so.

The Chairman said with regard to the use of the material for telegraph insulators, a certain number had been supplied to the Post Office; but the manager told him that they would be tried for two years before a conclusion would be come to respecting them. The other point was most important, and it was the very point they were having investigated. The directors believed there was some fallacy in the statement of accounts which had led to the position of affairs they fancied they were now in, and they did not think, from the elements that had been looked into, of the cost of the articles they supplied, and the price at which they sold at, that it was possible that they were carrying on at a loss.

A Shareholder asked if there was any chance of the parent company taking back their patents, instead of transferring fresh rights.

The Chairman said he had not asked them that question.

Another Shareholder remarked that the chairman stated it was owing to the non-extension of electric lighting that their produce had not been manufactured largely. Had they supplied any to those companies—such as the Edison and Swan—that were doing a large amount of business all over the country.

The Chairman replied that he understood that they had supplied the Edison Company, and also other persons who dealt with electrical companies.

Mr. Harrison asked if it was true that the only report of the Post Office authorities was distinctly against insulite.

The Chairman said he had seen no such report.

Mr. Harrison proceeded to state certain experiments he had made with the material, which, he said, had resulted very unsatisfactorily. He was told that it would not absorb water, but he had found that it did. He wished to know, too, whether it could, as was alleged, be turned on a lathe—not only with remarkable ease, as the prospectus stated, but at all. He had occasion at their last meeting to remark upon the unsatisfactory state of affairs, and upon the absurd lecture on electricity by Dr. Fleming, which that gentleman himself well knew had no more to do with their special product than the man in the moon. Things were still more unsatisfactory now; nothing, in fact, could be more unsatisfactory. On the last occasion he should have made the suggestion he now intended to submit, but that he saw the temper of the shareholders was against it. He had since disposed of a number of his shares, and had now but a small interest in the company. It was plain to any business man that the position of the company was hopeless, and that the more insulite they made, the more money they would lose. Whereas a call of £1 would now be necessary to wind up, a year hence £2 might be required. They had lost their money, and the only thing for them was to make the best of a bad bargain, and not lose any more. His notion was to appoint a committee, with instructions to take such steps as might be found necessary to immediately put a stop to expenditure and wind up the company, and to take legal advice whether or not the statements made in the original prospectus were so incorrect and misleading as to make the directors jointly and severally liable to the shareholders for the loss they had sustained. He ultimately moved "That a committee of shareholders be formed for the purpose of an independent investigation of the affairs of the company."

Mr. Iredell seconded this amendment.

Mr. Jackson pointed out that they were on the horns of a dilemma. It must be remembered that their product was a competitive one, and immediately they raised the price they would kill the sale. If they continued to sell they would lose, and if they ceased to lose they would kill the sale. He did not agree with the strictures made upon the present board by those who had previously spoken. Like a great many other persons who had made bad investments, they desired to throw the blame on any but themselves. But one objection he must take to the action of the directors—that, after the demonstration they had had, they still said, in the sixth paragraph of their report, that insulite possessed the peculiar properties at first claimed for it.

The Chairman said he started with the statement that the report itself could not be considered, in the present state of things, satisfactory. There were two distinct things running through the statements that had been made; whether the material was what it was asserted to be was one thing, and the other was whether they could make it profitably. As regarded the first, he was not a scientific man, but he thought the best possible evidence they could have of its success from a scientific point of view was the use made of it. They did not find a demand made full-grown; they must create it, and the business must have an

infancy before it could reach manhood. It did not follow because it was unprofitable at the outset that it was always to be unprofitable. Here they had a thing of scientific value; it had been used in Sir William Siemens' railway, and was still used; it answered the purposes for which it was intended. With regard to the questions raised by Mr. Harrison, he understood that Sir William Thomson had tried it with a screw, and that he had found it answer; whilst some of the material that he (the Chairman) had seen had been through a turning lathe. To appoint a committee of investigation meant to put a stop to the whole thing; it would, moreover, be a vote of censure on the directors, who had done their best to make the concern profitable and successful. He must lament that it had not been immediately profitable, but, whilst there was not the least doubt about the scientific value, he did not despair of the commercial value. He was quite sure, however, that if they carried such a resolution as Mr. Harrison had proposed, they would knock the whole property on the head. He was not aware of any statements in the prospectus which were misleading, and he could not imagine that there were any such. The real question was whether, because they were disgusted—and naturally so—that there was not a larger demand for what they turned out, they would knock the whole thing on the head, or whether they would wait for the result of the subsidiary investigation by a competent man.

A Shareholder desired to know whether Dr. Fleming still believed in the material to the same extent as he did twelve months ago. For himself, he felt more convinced of its value than he did a year ago, and it seemed to him that the facts proved that they had a unique as well as a valuable property. He was informed that other materials had been tried in the electric railway, and none had been found to answer except theirs; therefore he thought they might, if necessary, venture to raise the price.

Dr. Fleming, replying to various questions, said one speaker had remarked that the chief insulating materials were composed of vegetable substances, and that this company could not compete with them. They could compete with them. The whole of the gutta percha in the market would hardly be sufficient for laying down the electric mains of a town the size of Birmingham. The only way in which they could lay down insulated mains, was by laying them in material of the sort that they produced, which they could mould into bridges in which they could be laid, and as a complete answer to the remarks of the speaker he had referred to, he might say, he had now before him a proposal to prepare an iron mould to manufacture bridges of insulite on which to lay down, on a very large scale, such electric mains. He thought, however, that certain of his remarks were calculated to seriously mislead, so he would answer them a little in detail. In the first place he said he had made some small experiments himself, which showed him that this insulite was not what it was intended and represented to be. He contended that he had not made the very smallest attempt to satisfactorily test the material in a proper way. They could not possibly secure that every one of the thousands of articles made, say in stone-ware, should be perfect; there were sure to be some defective and cracked; and they could not ensure that every article made with "insulite" would be perfect, and one article of insulite taken at random, certainly did not condemn the material. The only way in which they could obtain any knowledge on that point, was to ascertain what the material had done in actual practice, and if what was claimed for it was found to be correct. In the first place it was put forward as a material which had very high electrical insulating qualities. Was there any case in which it had been found to have a valuable insulating property, so as to enable it to replace china and glass with advantage? Certainly there was, in the case of Leclanché's battery cells. These cells were made of glass, and electrical leakage took place over the glass cells to an enormous extent. This company had supplied a firm who used a large number of batteries of glass for synchronizing clocks, and these glass cells had to be attended to very frequently owing to the leakage that took place. At their request they had put their insulite batteries in, and the electrical insulation of those batteries was such that since they had had them they had had no difficulty in the matter. With regard to the remark made that the material absorbed water, of course it did not do so. It was perfectly obvious that if it did absorb water it could not remain in the open air, exposed to the weather, as insulators for telegraphs must be. A complete answer to that remark was that it was used in the Portrush Electrical Railway simply because it did not absorb water, and that was laid down upon 7,000 insulite bearers. He (Dr. Fleming) was informed by the engineer of the line that there was only a loss of electricity of three-quarters of a horse-power in the whole distance of seven miles. They first laid the railway over a bed of asphalte, but they found that they could not work the railway beyond two miles, simply because the loss of electric energy was so great. They then laid it with insulite, and since then they had found not the slightest trouble. Then again, the value of it was proved by the fact that where they made sales they got repeat orders. That was the most convincing answer that he could give to the statement that the material was not what it was represented to be.

The Chairman then put the amendment for the appointment of a committee of investigation, but only five shareholders voted for it, the original motion being carried by a large majority.

Sir George Rickards and Mr. Easton having been re-elected on the board of directors, and the Chairman having given a distinct undertaking that a meeting should be convened shortly to hear the result of the investigation by Mr. Price, the auditor, the proceedings terminated.

The South African "Brush" Electric Light and Power Company, Limited.

AN extraordinary general meeting of this company was held at the Cannon-street Hotel on Tuesday, convened in compliance with a requisition, for the purpose of considering a resolution to wind up the company voluntarily. Lieut.-Col. Coxon, presided.

The secretary (Mr. Thomas J. Seel), having read the notice convening the meeting,

The Chairman said—I would now invite any shareholder to propose the resolution named in the notice, "that the company be wound up voluntarily." It may be as well for me at the same time, to tell you that we think it would be better if you would let the matter drop. It is scarcely to the advantage of a public company under any circumstances, and, I may say, particularly under ours, to ventilate too much of its affairs, and on this occasion we would avoid that. I may perhaps show you the way to do so, by telling you that it is of no use to propose the resolution. We hold 200 proxies more than sufficient to defeat it, and it is absolutely certain that if proposed, it will be defeated. It is suggested that I might say a few words about our own policy. Gentlemen, you know it. There is not, I believe, one gentleman who signed that requisition, and certainly not one of those with whom it originated, who are not aware that there is scarcely the slightest divergence between the policy of the directors and that of the shareholders. Everything we have done, every advice, every counsel, every order we have given in the matter to our representatives at the Cape, have all pointed to the final some-day winding up of this company, that is, when it can be done to advantage, or when best it can be done. We have suspended all extension of our operations; we have refused to take fresh contracts, simply because the present position of affairs at the Cape makes it impossible for those contracts to be offered to us at a remunerative price. We have restricted our operations to the field which at present exists, and even there have limited ourselves to the perfecting of the light, and with a result that challenges question. The lights at Kimberley are excellent; the lights at Cape Town are excellent. Our electrician at Kimberley is a zealous, hard working, intelligent and a very excellent young fellow, and has merited the thanks of the company for the way he has conducted our affairs there. The light is so good at Cape Town that the dock company has solicited us to give them another contract, and we have declined to do so. We are confining ourselves to perfecting the lamp in order to enhance the property when the time comes—to realise, is the word that is suggested to me to use, but the least we say about realising the better. In private discussion the directors have not a single idea that would be concealed from any of you, and there is therefore less necessity for a public discussion of the matter. The Rev. Mr. Johnson made a mistake, no doubt unintentionally, in calling attention to the sum of £844, which he alleged had been expended in machinery, notwithstanding that we had in our report assured the shareholders that we did not intend to spend any more money in extending our work. That amount included a large number of carbons, and other necessary materials, and a dynamo, not for any fresh work, but as an actually necessary precautionary supplement to our contract at Kimberley, for with a large installation like that, where we have 35 lights on a seven mile circuit, it is dangerous to work with one dynamo only.

The Rev. H. J. Johnson said it was his intention to have suggested winding up voluntarily; he was still decidedly of opinion that it would be best to do so, and he was prepared to support his view at any length. But under the circumstances the chairman had stated, that the directors, who were opposed to the course, were able to control the voting power of the company, it appeared to him to be for the interest of those shareholders who had deposited their proxies in his hands, that he should abandon the proposal. (Hear, hear.) The position, as he understood it, was this: in order to obtain the sanction of a resolution of this nature, it was necessary that it should be supported by three-fourths of the number of votes; there were, he believed, something less than 2,000 votes (1796), so that, as the directors had in their hands over 600, it was quite plain that, unless they were open to conviction—and he supposed they were not, having spoken so very determinedly—it was useless to bring the matter forward, and under those circumstances he begged to withdraw from proposing the resolution. He must, however, guard himself from expressing entire concurrence in all that had fallen from the chairman's lips. He thought it was patent to every one who had examined the accounts, that the position of the company at the end of the year 1883 was distinctly less favourable than at the end of June in that year, so that, so far from paying its way, the longer the company went on the smaller would be the capital in hand. (Hear, hear.) For that reason he thought it would be best to wind up.

The Chairman: You must not forget that the Kimberley contract does not expire until the end of August.

Mr. Johnson: The total of your assets at the end of the year 1883 is less than the total of the assets in the middle of the year 1883; hence the Kimberley contract, as balanced by others, is worthless. (Hear, hear.) The rev. gentleman contended that there would be no difficulty in keeping up that contract, if the company went into liquidation voluntarily, for there need be no litigation—[Mr. Dickson, a director, questioned that]—and no abandonment of a profitable contract.

The Rev. Mr. Cooper, asked if the revenue was sufficient to meet the expenditure? If not, he certainly thought liquidation would be the best course to adopt.

The Chairman replied that they were covering their expenses. They had a very large expenditure, but their expenses were also very large. Quite lately, they were hit very hard by the extraordinary rise in the price of fuel; but there had been heavy rains recently, and the expenditure in that direction would be much diminished.

Mr. Hamilton read a letter from a correspondent, who was a shareholder in this company, at present at Cape Town, who, writing on the 9th of January, said "The South African Brush business is a bad business for us; one of the directors, who is here now, quite agrees with me that the sooner the company is wound up the better; the board ought to authorise him to sell out here and at Cape Town, and save the little money they have," &c.

A Shareholder inquired if the board had considered the advisability of approaching the vendors with a view to the money paid when the company was floated being wholly or partly refunded.

Mr. Shorrock hoped no such course would be adopted, and said that at the time the contract was entered into the sum paid was considered a fair one by the shareholders, and, if twice the amount had been asked, he had no doubt the shareholders would readily have subscribed it. Had the company been a success, would they have proposed paying more than was at first agreed upon? The proposition was a miserable one, and he hoped it would not be entertained.

The Chairman said they had not considered the question, and he did not think it was likely they would do so.

Mr. Howe asked whether, seeing the position of the company, the directors would continue to take their fees.

The Chairman said he should certainly decline to give his time and services to the interests of the shareholders gratuitously. The board divided £300 a year; they were entitled to £1,000.

Mr. John Taylor asked if the chairman would give a little more definite information as to what the board saw in the future to induce them to keep the company going.

The Chairman said they hoped their lights would become so indispensable to the Kimberley corporation by the time the contract expired, or even before then, that they might make an offer. They were paying a very high figure, the contract having been made in palmy days, and they could, no doubt, carry it out cheaper themselves. Mr. Atkinson, a director, was also feeling other corporate bodies at the Cape, with a view to the adoption of the light by them on their own account.

Mr. J. W. Anderson then moved the resolution standing on the notice paper to be proposed in the event of the motion for winding up being negatived, viz., "That the capital of the company be reduced from £100,000 to £50,000, the 20,000 shares already issued, and constituting the present capital of the company, being reduced from £5 each to £2 10s. each."

Mr. Dickson seconded this resolution, which was carried unanimously, the meeting then separating.

The Cuba Submarine Telegraph Company, Limited.

THE following report of the directors for the half-year ending 31st December, 1883, is to be presented at the 25th ordinary general meeting of Shareholders, to be held on the 13th inst.:—

The directors beg to submit, duly audited, the balance-sheet and accounts for the half-year ended 31st December last. From these it will be seen that the gross receipts, including the balance brought from last account, amount to £18,990 8s. 8d., and the gross expenditure, including the half of the annual payment on account of the 1881 cable, and the amount expended on renewals of cable and repairs, to £9,796 0s. 9d., leaving a sum of £9,194 7s. 11d. to the credit of revenue account. Of this the dividend on the preference shares will absorb £3,000, and leave £6,194 7s. 11d., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, free of income tax, the balance of £594 7s. 11d. being carried forward to the current half-year's account.

Considering that the extraordinary expenditure on renewals of cable and repairs during the half-year has amounted to £4,021, the directors have not thought it necessary to make any further addition to the reserve fund beyond the interest thereon, which raises it to £55,350. The Batabano-Cienfuegos (original) cable broke down on 17th ultimo, while the new shore ends of the Cienfuegos-Santiago 1875 cable were being laid. The former section not being duplicated, the company's engineer immediately proceeded to the repair. This was successfully accomplished without loss of time, the interruption having continued for only 11 days, during which period messages were forwarded over the land lines of the government. Mr. Keith has since successfully completed the laying of the new shore ends of the Cienfuegos-Santiago 1875 cable, and has also laid a new harbour length at Cienfuegos, and the directors have much pleasure in reporting that all the cables are now in good working order.

The renewals and repairs have been carried out most economically, the whole cost being approximately £6,000. The tax to be returned by the Spanish Government, referred to in last report, has not yet been received, but it is hoped that the claim will be settled within a very short time. A further reduction has been made in the rates for Colon and Panama traffic to meet a like step on the part of the Central and South American Company.

International Electric Company. — The accounts show that the general expenditure during the period from the 13th June, 1882, to the 31st October last, had been £20,435, the largest items of which consisted of £10,003 for salaries and wages, and £2,000 for directors' remuneration. Of this latter amount, £500 is shown as unpaid on the balance-sheet. The total paid-up capital (exclusive of £1,987 for arrears of calls) was £130,016. The cost of the patent rights is set down at £75,000, of which £27,000 was paid for in cash. The receipts from interest and discount had been £438.

Brush Midland Electric Light and Power Company, Limited.—A petition, confirming a resolution reducing the capital of this company from £250,000 to £70,500, was, on the 18th of January, presented to the Chancery Division of the High Court of Justice, and is now pending before Mr. Justice Pearson; the list of creditors of the company is to be made out as for the 11th of March.

The Great Northern Telegraph Company.—On and after the 1st of February the rate for messages from Hongkong to Canton will be 5d. per word, with a *minimum* of seven words per message. The charge for messages from all stations in Great Britain to Canton will therefore now be 8s. 9d. per word.

Great Northern Telegraph Debentures of 1883 (Series B).—The numbers are published of 100 debentures of £100 each, drawn in Copenhagen on the 24th January for repayment on the 1st of March next, at the office of Messrs. C. I. Hambro & Son, 70, Old Broad Street, E.C.

The Telegraph Construction and Maintenance Company, Limited.—The directors notify that, subject to the audit of the accounts, they propose paying a dividend of 15 per cent. (£1 16s. per share), in addition to the *ad interim* dividend of 5 per cent. already paid, making 20 per cent. for the year 1883.

Eastern Extension Australasia and China Telegraph Six per cent. debentures.—The coupon due on the 1st instant, is payable at the Consolidated Bank, 52, Threadneedle Street, E.C.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of January was 3,291, estimated to produce £3,000, against 2,954 messages, producing £2,829 in the corresponding month of last year. The receipts for the month of October, estimated at £2,700, realised £2,744.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st January, are £2,867, as compared with £2,588 in the corresponding period of 1883. The October receipts, estimated at £4,524, realized £4,660.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending the 1st of February, 1884, were £2,100, after deducting the "fifth" of the gross receipts payable to The London Platino-Brazilian Telegraph Company, Limited.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of January, 1884, are £2,045, against £1,672 in the corresponding period of last year.

The Great Northern Telegraph Company. The receipts in January, 1884, were £19,360; corresponding month, 1883, £18,390; 1882, £17,110.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending January 31st, amounted to £4,500.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and of Electricians.

An ordinary general meeting of this society was held on the 31st ult., Professor W. G. ADAMS, president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of new and proposed new members read, the Secretary announced that Lady Siemens had presented to the society 300 volumes of scientific works, which had been collected by the late Sir William Siemens. A motion was then proposed and seconded, that the thanks of the members be given to Lady Siemens for her valuable donation.

A paper was then read by Mr. E. BRIGHT, on "A System of Electric Fire Alarms." Mr. Bright commenced his paper by pointing out that seven years ago a paper had been read on street electrical calls as adopted in foreign cities. At that time none were in use in London. During the last three years, however, an extensive system had been carried out, but the subject deserved far more attention than had yet been given it in this country. Simplicity and reliability were the great desiderata in fire alarms. It was usual to employ clockwork mechanism to enable the locality of the call to be notified. In the author's system, a far simpler arrangement was adopted; this was founded on the principle of Bright's differential method of detecting faults in insulated wires devised in 1852. Mr. Bright then proceeded to describe his system, which is the same as that illustrated in the number of the REVIEW for Feb. 15th, 1879. At the present time there were 21 fire stations in connection with the systems, there being 140 call points and 82 miles of line. The hindrance of local boards greatly prevented further extensions of the calls, the Wandsworth Board especially had been obstructive in the matter. Mr. Bright then pointed out the great advantage of having "thermostats" placed inside buildings so that the notice of a fire should be automatically given as quickly as possible. Street calls were, as a rule, too late, as a fire might have made great headway before it was noticed outside the house. The thermostats could be added at a very slight

expense, in all cases where the house was already fitted with electric bells. The amount of saving effected by the use of fire alarms was enormous; the damages paid on the insurance, in cases where the automatic alarms were used, being as low as 5 per cent., whereas, in other cases, it was as high as 24 per cent. The actual saving effected in one year was equal to £258,000, and if detectors had been universally fitted, the amount would have reached £692,000. The American insurance companies, in some cases, reduced the insurance premium 25 per cent. in cases where detectors were used. At the present time a general reduction of 10 per cent. was made in such cases. The utility of fire detectors for country mansions was extremely great. If the insurance companies desired they could give a great impetus to the introduction of fire alarms; but this course was not to their advantage, as every fire greatly increased the number of insurers. Besides, safety to *property*, safety to *life* ought to be considered, and for this reason the use of alarms might, with advantage, be enforced by Act of Parliament. In conclusion, Mr. Bright stated that his system had been exhibited at the Paris and London exhibitions, and had received gold medals at each.

In the discussion which followed the reading of the paper,

Mr. C. E. SPAGNOLETTI referred to the adoption of thermostats to indicate whether signal lamps were alight or not. For large buildings a large number of bells in one circuit were necessary for alarms. It was found difficult to cause a number of these bells to ring, but the difficulty was got over by placing an earth contact spring, against which the armature touched when attracted, in each bell; with this device it was found that almost any number of bells could be placed on one circuit, and they would all ring properly.

Mr. VON FISCHER TREUENFELD referred to his paper on "Fire Telegraphs," read before the Society in 1877, and he again drew attention to the enormous reduction in serious fires which was effected by the use of telegraphic communication and street fire alarms, this reduction being from 29 per cent. in the case where no telegraphic communication was employed, to 17 per cent. where simple telegraphic instruments were used, to 4 per cent. where street alarms were erected. In continental towns there was one place of call to every two or three thousand inhabitants; in England the proportion was as small as one to from 15,000 to 80,000. He proposed that a committee should be formed by the Council to draw up a statement of facts with reference to fire-alarms, and to report upon the subject.

Professor AYRTON, Sir CHARLES BRIGHT, and Mr. SPRATT also took part in the discussion.

The meeting then adjourned.

Physical Society, January 26th, 1884.

Prof. CLIFTON in the Chair.

New Member.—Jung Frei, Secretary of the Chinese Legation.

Prof. CLIFTON announced that Lady Siemens had presented a portion of the late Sir William Siemens's library to the Society. The meeting, which was at first a special meeting to consider the resolution that it is expedient for the past presidents of the society to be permanent vice-presidents, having agreed to this resolution, was constituted an ordinary meeting, and

Profs. AYRTON and PERRY described and exhibited their new ammeters and voltmeters, also a non-sparking key. The well-known ammeters and voltmeters the authors used for electric light work are now constructed so as to dispense with a constant, and give the readings in ampères and volts without calculation. This is effected by constructing the instruments so that there is a falling off in the controlling magnetic field, and a considerable increase in the deflecting magnetic field. The deflections are thus made proportional to the current or E.M.F. measured. The ingenious device of a core or soft iron pole-piece, adjustable between the poles of the horseshoe magnet, is used for this purpose. By means of an ammeter and voltmeter used conjointly, the resistance of part of the circuit, say a lamp or heated wire, can be got by Ohm's law. Profs. Ayrton and Perry's non-sparking key is designed to prevent sparking with large currents. It acts by introducing a series of resistance coils determined experimentally one after the other in circuit, thereby cutting off the spark.

Dr. C. R. ALDER WRIGHT, F.R.S., read a paper on the "Electromotive Force set up during Interdiffusion," being the result of experiments made by himself and Mr. C. Thompson, to determine the effect of varying densities of solutions used in voltaic cells on their E.M.Fs. The observations were made by constructing the cells of pure materials, and opposing them so that the differential E.M.Fs. could be measured by galvanometer or quadrant electrometer when solutions of different densities were employed. The following general conclusions were reached:—(1.) In any two fluid cells containing solutions of two metallic salts and plates of the respective metals contained therein, an increase of strength in the solution surrounding the plate acquiring the higher potential, in virtue of the normal action of the cell, causes an increment in the potential difference between the two plates; and the opposite effect is produced by an increment in the strength of the solution surrounding the other plate. (2.) A law of summation holds expressible thus: the effect of the sum of a series of changes in the strengths of the solutions in a two-fluid cell is equal to the algebraic sum of the effects of each change severally. The author considered this law very fully, and pointed out that "diffusion cells" act at least partly after the fashion of thermo-couples transforming into electric energy a certain amount of sensible heat.

NEW PATENTS—1884.

2240. "Holders for incandescent electric lamps." E. H. THOMSON. Dated January 28.

2264. "Electric incandescent lamps and switches for same." H. J. HADDAN. (Communicated by C. G. Perkins.) Dated January 28. (*Complete.*)

2266. "Regulating electro-dynamic motors." T. J. HANDFORD. (Communicated by F. J. Sprague.) Dated January 28.

2278. "Regulating or controlling electric currents." J. H. JOHNSON. (Communicated by E. Bertin.) Dated January 28.

2285. "Holders for incandescent electric lamps." C. DORNFIELD. Dated January 28. (*Complete.*)

2294. "Spring compensators for signal and telegraph wires." J. D. HALL. Dated January 29.

2305. "Machinery for covering telegraph and other wires with gutta-percha or similar plastic substances." W. HANCOCK. Dated January 29.

2306. "Machinery for covering wire or strand with gutta-percha and similar plastic substances, also applicable to the manufacture therefrom of tubes or cords." W. H. WARDALE, D. PHILLIPS, W. HANCOCK. Dated January 29.

2309. "Switch for electric purposes," E. C. GEE. Dated January 29.

2327. "Galvanic batteries." J. RAPIEFF. Dated January 29.

2383. "Galvanic batteries and obtaining commercially valuable residual products from the employment of such batteries." F. H. GOSSAGE. Dated January 30.

2405. "Galvanic battery." H. FAIRFAX. Dated January 30. (*Complete.*)

2428. "Electric bells, motors, and other apparatus." J. C. BAYLEY. Dated January 31.

2464. "Waterproof and magnetic sock." J. S. and A. J. WOODINGTON. Dated January 31.

2467. "Treating carbon filaments." H. J. HADDAN. (Communicated by C. G. Perkins.) Dated January 31. (*Complete.*)

2481. "Galvanic batteries for medical and other purposes, and apparatus for applying electricity to the body." J. D. PULVERMACHER. Dated January 31.

2494. "Improvements in galvanic batteries and in means for supplying the exciting liquid to, and removing it from the same." F. D'HUMY. Dated January 31.

2497. "Signalling apparatus." H. G. ELLERY, J. T. GENT. Dated January 31.

2510. "Electric logs." W. G. ROTHWELL. Dated February 1.

2521. "Accumulator of electricity." J. MYERS. Dated February 1.

2535. "Telephone holder." G. W. ERRINGTON, F. CAWS. Dated February 1.

2544. "Armatures of dynamo-electric machines." T. PARKER, P. B. ELWELL. Dated February 1.

2588. "Apparatus for driving dynamo-machines." T. SUTCLIFFE. Dated February 2.

2631. "Regulating the distribution of electricity in working with induced currents." J. D. GIBBS. Dated February 2.

2632. "Electro-magnetic apparatus." J. B. THISTLETON. Dated February 2. (*Complete*).

2639. "Supporting and insulating electrical conductors." W. R. LAKE. (Communicated by J. W. Tringham). Dated February 2. (*Complete*).

2674. "Insulating wires for use as electric conductors." W. E. HEYS. Dated February 4.

2676. "Method of and apparatus for conveying the light evolved from an incandescent electric lamp into parts or cavities of the human or animal body for surgical, dental or other purposes." P. WARD. Dated February 4.

2681. "Incandescent electric lamps for decorative purposes." J. G. LORRAIN. Dated February 4.

2696. "Lightning arrester for electric lines." A. M. CLARK. (Communicated by C. W. McDaniel). Dated February 4.

2703. "Arc electric lamps." J. H. JOHNSON. (Communicated by La Compagnié des Fonderies et Forges de l'Horme). Dated February 4.

2707. "Automatic telegraphy." W. P. THOMPSON. (Communicated by T. F. Taylor). Dated February 5. (*Complete*).

2708. "Telephone receivers." W. P. THOMPSON. (Communicated by T. F. Taylor). Dated February 5. (*Complete*).

2722. "Apparatus for enveloping insulated conductors partly applicable in the making of lead pipes." J. J. HARROP. Dated February 5.

2727. "Electric water alarm." N. Frére. (Communicated by C. Schvefs). Dated February 5.

2740. "Apparatus for generating electricity." R. DISHER, W. LICHFIELD. Dated February 5.

2746. "Galvanic cells having regard to electrical generation and storage and to the utilisation of the electrolytes." S. H. EMMENS, O. MARCH, United Patents' Corporation. Dated February 5.

2747. "Construction of galvanic batteries." S. H. EMMENS, O. MARCH, United Patents' Corporation. Dated February 5.

2748. "Electrolytes and the manufacture of chemical products therefrom." S. H. EMMENS, United Patents' Corporation. Dated February 5.

2750. "Construction and working appliances of galvanic batteries." S. H. EMMENS, United Patents' Corporation. Dated February 5.

2754. "Means for facilitating communication and electric lighting in railway trains." T. J. MORTIN. Dated February 5.

2758. "Electric conductors and method of making the same." A. A. COWLES. Dated February 5.

2762. "Construction of secondary batteries or accumulators and their application." E. U. PAROD. Dated February 5.

CORRESPONDENCE.

Primary Batteries.

Your remarks on Primary Batteries in your issue of January 19th, were in every way to the point.

It is strange that there should still be the secrecy (and the coinage of new words, I presume in order that the English language may be able to keep the secret), when it is obvious that each and all of these remarkable inventions are worked by modifications of Bichromate solutions with acids and chlorides, and also that most of these batteries have come forward since the "Granule" was introduced, for which its originator claims no such results or secrets, and which any one can make. As an experimenter with primary batteries, I fear these sanguine promoters will find that no cell requiring double fluids, or porous division will be a commercial success. It must be produced by simpler methods.

An Electric Spark.

Experiments by Eminent American Physicists with Telephones. (No. 2.)

I send to you further extracts from the affidavits referred to in my communication published in the REVIEW of 2nd inst.

These experiments were made at the Stevens Institute, Hoboken, with the Hopkins transmitter and receiver, by Profs. Morton and Mayer, assisted by Prof. Thurston, Mr. Gustavus G. Wagner, Mr. J. M. Hicks, William C. Hicks, and others.

"The transmitter was connected with the primary of an induction coil and battery, and the receiver was in the circuit of the secondary wire; when a tuning-fork, producing the note U^1_3 was sounded, by means of a violin bow, above the diaphragm of the transmitter we heard the note U^1_4 or the octave above U^1_3 in the receiver, and no other note was heard in the receiver. By several experiments with the tuning-fork U^1_3 and a resonator U^1_4 we proved that no note U^1_4 was sounded by the U^1_3 tuning-fork."

"This apparatus, therefore, caused the octave of the note sounded upon the transmitter to be sounded and heard in the receiver, and it is clear that the coil doubles the number of vibrations in the receiver and thus raises every note an octave higher."

"The utmost care was taken in these experiments to secure accurate and correct results. A tuning-fork U^1_3 and also a tuning-fork U^1_4 were placed in the room where the receiver was and at a distance from the room where the transmitter was, and each fork was sounded alternately to enable the hearer to determine accurately the note heard in the receiver, and in all cases we heard a note an octave higher than the one sounded at the transmitter. When a tuning-fork U^1_3 was sounded at the transmitter a resonator U^1_4 was placed in contact with the receiver and the sound was distinctly heard in it. It is a well-established fact that a resonator will not respond to more than one tone, and that tone in the resonator we used was U^1_4. Speech was thrown on the transmitter by the voice of the person sounding the fork U^1_3, and we heard the octave of U^1_3 and also good, distinct articulate speech."

"There are makes and breaks of the electrical circuit which occur at irregular intervals and produce noise, and there are other makes and breaks which occur at such intervals as produce tones and harmonies."

"The latter are the makes and breaks which may occur at the proper intervals and reproduce articulate speech, and which do reproduce music and harmonies. That in articulate speech certain qualities do exist which are characterised as musical tones, fundamentals and overtures or harmonies cannot be denied. Such were the makes and breaks in the battery circuit, which did reproduce articulate speech in the telephone in our experiments with the phonograph cylinder in motion. Therefore, if makes and breaks in the electric current occur at the proper points and with proper frequency and intervals of time between them, they will not produce a noise or distorted speech, but will produce musical notes and harmonies, with articulate emphasis and expression which are characteristics of all articulate speech and also of articulate singing, as well as of all the grades of articulation ranging between them—from *plain tone speech* to musical articulation or singing."

The above extracts are taken from affidavits made on the part of the defence, to which I will now add some extracts from affidavits made by other eminent physicists on the part of the plaintiff, viz., The American Bell Telephone Company.

Prof. Cross testified "the experiment with the phonograph so far as it proves anything, proves that a contact of varying pressure will give articulate sounds, and that the interruption of the current not oftener than once in each complete vibration, will not absolutely prevent the listener, by close attention, hearing such familiar phrases as 'Do you understand me?'" . . . "The complete vibration caused by the articulate speech of a man's voice in ordinary conversation occurs between 200 and 300 times a second. I am perfectly sure, from experiments, that an interruption which is as brief as $\frac{1}{10,000}$ of a second, and occurs as often as 200 times a second, will be offensively noticeable in the telephone as a disturbance." . . . "The relative interval between two successive makes and breaks and between any make and the following break, is an important factor in determining the result that will be produced."

In regard to Mr. Hopkins's transmitter, Professor Cross testified "in a sense, it may be said literally that such an instrument breaks the circuit, and yet that it transmits speech. Just so far as it breaks the circuit it fails to transmit articulation, and if this failure is not fatal to the result it is because the proportion of break of the current to preservation of the current is such as to be *negligible*, or not utterly destructive; it does not transmit by breaking, but in spite of an occasional break."

Professor Wright, in his affidavit for the Bell Company, said, "Breaks of excessively short duration, and at considerable intervals, will disturb articulation, but will leave enough of the vocal sounds to enable one to recognise the sentence or the word. . . . A microphone will transmit speech in spite of occasional breaks."

Do not the affidavits of these physicists establish the following facts?—

1. Articulate speech can be transmitted and reproduced in a rapidly-interrupted electric circuit.

2. By means of an intermittent or discontinuous current, clear, distinct, and perfectly intelligible articulate speech can be transmitted and reproduced.

In the face of these facts, what value is to be given to the opinions of those physicists who have so persistently maintained that an unbroken undulatory cur-

rent was absolutely necessary for the transmission and reproduction of articulate speech?

Should they not either accept the testimony of these American physicists, or disprove their statements?

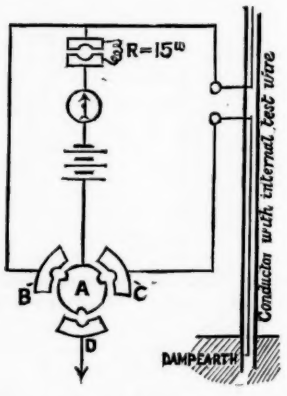
Das Telephon.

Feb. 4th, 1884.

NOTE.—The British patent of the Hopkins transmitter is No. 688, 1882; the receiver, No. 689, 1882.

Protection from Lightning.

The discussion of Col. Parnell's paper at the Royal Institute of Architects on the 21st inst. was wholly taken up in disproving his revolutionary ideas, so that there was no opportunity of dealing with the question of testing lightning conductors. However, your timely article, and the extract from Messrs. Munro and Jamieson's coming work, dealt with the subject, and is most welcome, seeing the full reports and consequent attention paid to Col. Parnell's paper by the architectural and building press. Mr. Jamieson's article will, doubtless do good, and be a guide upon a subject where silence has hitherto obtained. Whilst concurring in what Mr. Jamieson says, that a conductor ought not to give more than 1 ohm for resistance, I would venture to ask if a margin might not be allowed up to, say, 10 or 15 ohms, beyond which a conductor should be condemned as unsafe? And seeing that so few either have a Wheatstone's "bridge," or understand its manipulation, I have arranged a simple form of switch in connection with one of the British Insulite Company's Detector-batteries, which would be both compact and simple.



The connections are as follows:—Connecting $\frac{A}{B}$ short circuits detector, and proves its fitness for testing. Connecting $\frac{A}{C}$ takes the metallic circuit of conductor and test wire. Connecting $\frac{A}{D}$ tests the conductor proper, and by means of the resistance we can see if it is above the 15 ohms allowed.

Samuel Vyle.

Jan. 29th, 1884.

The New Patent Rules.

If Mr. Handford does not reply to "Patentee" I can clear up his difficulty.

The new rules do not refer to his stamp query, but it is of no use in these days referring to any one act or set of rules on any given subject under the impression that you will find all you want therein.

The Stamp Act of 1870 imposes a stamp duty of 2s. 6d. upon all declarations, with one or two exceptions (not affecting "Patentee").

Had he made his declaration before a Justice of the Peace the 2s. 6d. stamp would not have been required; this is possibly a relic of the times when justices were paid by fees, so as to attract the 1s. 6d. for the declaring fee in their direction.

By subsequent rules (under the Judicature Acts) the stamp must be an impressed one.

I think the patent officials have in this matter acted with a courtesy not always characteristic of government employés.

B. H.

Jan. 31st, 1884.

[The above arrived too late for insertion last week. Our correspondent will have seen, however, by Mr. Handford's letter that the matter to which "A Patentee" referred is now at an end.—EDS. ELEC. REV.]

Induction Coils and Electric Lighting.

It is not generally known that the system of distributing electric light by induction coils is given in a provisional patent by Sir C. Bright, No. 4,212, for 1878. The author says:—"At each point where the electric light is used, the light or group of lights is actuated by the secondary coil or coils of an induction apparatus fixed there. The primary coil of each induction apparatus is in circuit with a metallic main conductor, common to all, and connected with an electric battery or a magneto-electric machine, which generates the current at any convenient locality. The size and length of the primary and secondary coils of the induction apparatus are adapted to the number of lights employed at each point where the secondary currents actuate the electric light." The lights were to be regulated by shunt resistances to the primary coils. The use of induction coils for producing electric light from the secondary is also mentioned by Harrison in a patent, No. 588, of 1857.

Lux.

Jan. 28th, 1884.

[Sir Charles Bright's apparatus has been mentioned in our columns in connection with an article on the Gaulard-Gibbs secondary generators.—EDS. ELEC. REV.]

A Symbol for Dynamo.

A common graphic symbol for "dynamo," such as we have for "battery," would be a convenience. Might I suggest the figure $\overline{O}$ or $\underline{O}$ roughly representing the coil and brushes. The poles can be distinguished by making one dash or horn thicker than the other, as in the well-known battery symbol; thus $\underline{\overline{O}}$ would mean a continuous current machine (the upper pole being +, the lower −), while $\overline{\underline{O}}$ might stand for an alternating machine.

The symbol can be made up in type by the letter O and two dashes. It may also be represented by the letter "D," which it would be well if writers would agree to adopt for "dynamo" in diagrams, &c., just as "B" now stands for "battery" and "G" for "galvanometer."

Of course $\overline{O^{|}}$ might stand for a continuous machine, the upper being the positive pole; but $\underline{\overline{O}}$ assimilates more to the battery symbol.

J. Munro.

W. Croydon, *Jan. 29th*, 1884.

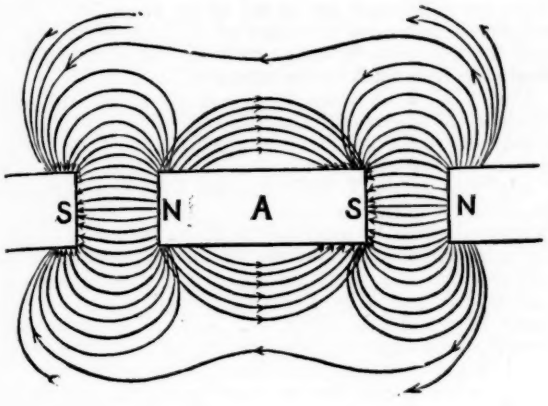
[With the exception of making the one dash thicker than the other, we think our correspondent's figure is very frequently seen. We agree with him that a *general* adoption of some such symbol would be most advisable. —EDS. ELEC. REV.]

The Theory of the Gramme and Unipolar Dynamo-Machines.

Mr. W. M. Mordey finds fault with my diagrams of the Gramme machine on the ground that the lines of force traversing the interior of the ring are shown flowing in the wrong direction, and asserts that "they can only be conceived doing so in a direction opposite to that shown." Such would certainly be the case if the ring were composed of non-magnetic material, but with an iron ring the interior lines of force flow in a direction opposite to the exterior.

The appended diagram will, I think, render this plain to anyone acquainted with the fundamental laws of magnetism. N, S, represent two magnetic poles,

between which is placed a bar of iron, A. It will be at once perceived that the lines of force proceeding from or entering the field magnet poles, flow from right to left, while those passing between the poles induced in the bar flow in the opposite direction. That this diagram shows the direction taken by the lines of force, when an iron bar is placed between two magnetic poles, no one can reasonably deny. But the theory that the lines of force in a Gramme ring flow



in a similar manner, will, of course, find *some* opponents as long as any of the "improved" Gramme machines, or their inventors, continue among "the 'things' that be." "E's." letter, and the editorial remarks on the circular issued by the Anglo-American Brush Company, render it unnecessary, on my part, to comment on that portion of Mr. Mordey's letter relating to the "Victoria" dynamo machine. In conclusion, I would remark that I am not interested, directly or indirectly, in the Gramme dynamo or any enterprise connected therewith. It is certainly very amusing for a person avowedly interested in a rival machine to accuse me of trying to advertise the Gramme. I "beg to remind him" of another fable, that of the "Pot and the Kettle."

F. de Wolffers fils.

Feb. 4th, 1884.

Bichromate Batteries.

In answer to your correspondent "W. M.," *re* bichromate batteries, the carbon plate, at and above the level of the solution, becomes gradually permeated with an insoluble crystal, most likely some form of chrome alum.

It is continually met with, and often causes a fracture of the carbon, while it is most detrimental to the action of the battery. To restore the carbons, place them in a furnace, and raise to a white heat, which answers every purpose without the use of mercury. I need hardly say that the carbons should be gradually heated, as if suddenly exposed to a fierce heat the expansion of the water in the crystal would cause immediate breakage.

An Electric Spark.

The Efficiency of the Heinrichs Dynamo-Electric Machine and the Gramme Ring.

Your correspondent "E" rightly stated in his letter in your last issue, that very different ideas are given to express the efficiency of dynamo-electric machines, his own in proof thereof; but he wrongly charged me of having sought to express the *total* efficiency of my machine by the number of Watts produced per pound of copper wire employed; although the high number of Watts denotes a high efficiency of the principle of construction of the machine, and the fact that my machine gives 50 watts per pound of copper wire is an indisputable proof of the high efficiency of its principle of construction.

As regard the 67 per cent. of the total current of my machine available for the external circuit, I submit that "E" ought to have mentioned that the current flowing was measured to be 33 ampères, and that the result was an extraordinary high efficiency for such a small machine. Can "E" name any machine of about the internal resistance of my machine, having only 16½ pounds of copper wire on its armature, giving a current of 33 ampères through an external resistance of about 3 ohms, the armature having the low circumferential velocity of about 1,600 feet per minute. (I shall show presently that the efficiency of my machine, when supplying the usual current of about 10 ampères as required for the usual arc light, is between 80 and 90 per cent.)

Your correspondent "E," when stating to your readers that the 67 per cent. efficiency of my machine was a low figure, seems to have been ignorant of the efficiency of the Gramme and its direct modifications, which he advocates. I have extracted the following figures from the tests made and published by Profs. Houston and Thomson, viz. :—

GRAMME.

Resistance of machine	1·7 ohm.
„ of external circuits (1 lamp only)	1·87 „
Current	14 ampère.
Current available for external circuit .	51 per cent ! ! !

The tests published of the unipolar machine having two gramme rings, show as follows :—

Current	13—15 ampère.
Current available for external circuit .	69 per cent.

Now, on reducing the external resistance of the circuits of the Gramme or unipolar machine so as to raise the current up to 33 ampères, what will be the result? very likely an efficiency of 25 to 30 per cent.

The following tables of tests of my machine were published by your contemporary *Engineering*, on the 29th July, 1881, in an article which is criticised by your imprudent correspondent as fallacious and misleading.

"The following figures give the results of a series of measurements of the Heinrichs machine recently taken by Mr. W. H. Preece, F.R.S., and Mr. Augustus Stroh :—

Mean number of revolutions of armature per minute	850
Number of lamps in circuit	3
Resistance of machine between terminals and including magnet coils	1·83 ohm.
Resistance of armature between brushes	·85 „
Resistance of each arc	1·24 „
Electromotive force	130 to 150 volts.
Current	33 to 38 webers.

"In the next table are given the results of a series of measurements made upon the same machine by Mr. H. R. Kempe :

Number of Lights in Circuit.	Number of Revolutions per Minute.	Current.	Diameters of Carbons.
		webers.	millimetres.
1	700	40	13
2	800	37	13
3	1,000	30·8	13

"Carbon resistances were then substituted for the lamps, and the following measurements were taken :—

Carbon Resistances.	Number of Revolutions per Minute.	Internal Resistance of Machine.	Current.	Electromotive Force.	Calculated Horse-power.
ohms.		ohms.	webers.	volts.	
2·1	700	1·83	36·4	143·3	7·1
2·6	800	„	33·7	149·3	6·7
4·3	900	„	26·3	160·0	5·6
7·3	900	„	15·7	143·3	3·0
7·3	1,000	„	17·7	161·6	4·0

Your correspondent "E," when calculating the efficiency of my machine, selected from the above series of tests a set of figures showing the largest current with consequently the lowest efficiency for the external

circuit. He must have been aware that when he compared my machine with others of its own class and size, that he was bound to select a set of tests where the current was nearly of the same quantity as in the other machines. If we take the last set of figures from the above tables, we have an external resistance of 7·3 ohms, and a still larger current of 17·7 ampères; thus, in this case, the efficiency of my machine will be as follows:—

$$\frac{7{\cdot}3}{7{\cdot}3 + 1{\cdot}83} = 80 \text{ per cent.}$$

From further tests made with my machine *I got 88 per cent. efficiency*, when I increased the external resistance to such an extent that the current became reduced to 10 ampères, which is the current required by the Brush lamps.

Since, in the before last-mentioned tests, carbon resistances were used, and in the last-mentioned tests, copper resistances, the results obtained are true results and can be checked at any time, and, in fact, they will be re-taken within a few days, along with the tests as to the efficiency of my machine converting horse-power into electricity.

At the other hand, the figures of the efficiency of most other machines were calculated from the *E.M.F. of one arc* out of a great number of lamps, thus any error made inadvertently or otherwise, became multiplied and increased the percentage of efficiency of the machine. No figures of the efficiency of any machine ought to be believed unless it be shown *that the whole current* of the machine was passed through a metal resistance and then measured.

The statement made in your contemporary *Engineering*, that an expenditure of 5½ pounds of copper wire per light was involved in my armature as against 10 pounds per light on the Brush armature, is a very low and too modest a figure, since I have actually burnt in Paris, in 1882, six Brush lights with my machine, without any noticeable heating of the wire on the machine, thus the correct figure will be, 2¾ pounds copper wire is used on my armature, as against 10 pounds on the Brush.

As known, it is *not* the short wire making few convolutions on the armature, and having a low resistance, which becomes hot; but the long wire, making a great many convolutions on the armature and having a great resistance, becomes hot, thus following the words of your correspondent "E," the person who buys the Heinrichs machine will *not be* "the unfortunate individual who has at the year's end to pay for horse-power expended in heating the wire of his dynamo.

I hope your correspondent "E" will now admit that all his attacks on the efficiency of my machine were groundless, and that the charge he made against the article in your contemporary *Engineering* as being misleading, was a breach of privilege for which, I trust, he will apologize in the next issue of your journal.

Any correction of the explanations given by me of the generation of currents on a ring armature, which were published in your journal on November 1st, 1880, and in *Engineering* on 29th July, 1881, must be directed to me, since I am responsible for the statements contained in those articles, and I shall be glad to answer any questions or earnestly-given explanations of any fallacies therein; but I shall certainly not further answer any flippant argument such as made by "E." If he professes to expose fallacies, he must not ask the other party to give reasons for the fallacies.

From the further text of "E's" letter I shall answer two of his arguments, relating to the generation of currents on a ring armature, showing plainly that "E" has been too much in the habit of thinking and accepting his own ideas instead of studying the subject. He says as follows:—

"With the statement made by M. de Wolffers regarding the idle wire on a Gramme machine, I agree. *To talk of one part of a coil being idle while another part of the same coil is active, is absurd and very misleading!!* I have always been in the habit of thinking that the E.M.F. in any dynamo machine with a ring armature is proportional to the number of lines of force passing *through* the ring at the brushes." . . . . (And further on, "E" says as follows):—"As a matter of fact, a Gramme machine will work without an iron ring at all, although very badly; badly, not because the lines of force cut the coil twice, but because *the maximum number of lines* which can be enclosed by a coil is very small, *the majority of them going through the centre of the ring!!!*" (For arguments sake, let the lines of force go *through* the ring 12 inches in diameter, how do the lines of force evade the iron shaft in the centre of the ring?)

Had "E." been more in the habit of reading the elucidations of our eminent authorities on these questions, he would not have exposed himself to such erroneous and contradicting statements. In answer to "E.'s" statements, I shall cite the following extracts from the "Memoire sur les courants d'induction developpé dans la machine de Gramme par M. J. M. Gaugain, annales de Chèmie et de Physique, 1873," adapted in the well-known work, "Eclairage á l'electricité par Hippolyte Fontaine," translated by Paget Higgs, L.L.D., 1878." . . . . After having described the experiment of the magnetised bar having acted on the copper helix, and on repeating the experiment, but removing the bar from the helix (*i.e.*, leaving the Gramme ring without an iron core, as mentioned by "E") it is to be remarked that all parts of the helix, with regard to the bar as far as the centre of the helixes, are in a certain direction, whilst the opposed parts are placed in inverse direction, *the inducing magnet will thus create a current of a certain direction in the first half of the helix, and a current of inverse direction in the second half.* (Is this absurd and misleading, as your correspondent, "E," stated?) The intensity of the first current will be superior to the intensity of the second, because the parts influenced are much more approximate to the inducing magnets. The *result of these two actions on the same coil* will be a very feeble current (being the difference of the two.) But when the iron core is in the interior of the coil, it *will prevent the magnetism of the inducing magnet acting on the second part of the helix* (the wire on the inside of a ring), and the total effect will be sensibly increased. This is not all; the soft iron ring has also the effect of concentrating the magnetic field of the inducing magnet, and of importing to it, consequently, much greater inducing power. *This is, according to M. Gramme, the principal cause of the production of currents of his machine.*

The same theory has been confirmed and minutely explained by one of the greatest German scientists and electricians, Dr. H. Schellen, in his work, "Die magnet und dynamo electrischen maschienen, 1879, 1882, 1883." And from all explanations given by these authorities, and M. Gramme himself, it appears that the wire rotating between the inducing magnets and the iron core is the most useful for the generation of currents; because the wire cuts the most intense lines of magnetic force, while the wire on the inside of the ring is but little acted upon by the magnetised ring. I have particularly shown in my theory of the generation of currents, when and under what conditions the iron ring acts upon the wire on its inner side. I further showed that when the armature is in action that the iron ring has during a great part of each revolution a double polarity (in its section) which gave rise to a double current in the coils, overlying that part of the ring, similar, as before described, of a Gramme ring without a core, it is evident that these double actions greatly reduce the efficiency of the machine. I then constructed my armature in such a manner that the wire on the inside of my ring became *very short*, and was placed out of the influence of the iron ring.

Concluding, I trust "E" will more fully study this interesting subject before he again appears before your readers as an all sweeping authority.

Charles F. Heinrichs.

London, *Feb. 4th*, 1884.